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ABSTRACT

Forum topics included discussions on: (1) "Provocative Perceptions: Space Achievement and Challenge"; (2) "International Cooperation and Competition"; (3) "International Space Programs"; (4) "Astronauts Memorial Foundation"; (5) "Prospects for U.S. Commerical Space Transportation"; (6) "Planning for the International Space Year"; (7) "Civil Program Updates"; (8) "East-West Launch Competition"; (9) "Moon--Mars and Beyond"; (10) "Initiate Space and Aviation Education"; (11) "Military Space Imperatives"; (12) "Military Services Report on Space"; (13) "U.S Space Operations"; (14) "Military Space R&D Policy"; (15) "Emerging Space Technologies"; (16) "The Strategic Defense Initiative"; (17) "SDI--Myth or Reality?" The "Space Law and Policy Forum" covered satellite telecommunications, remote sensing, and mediastat. During the "Space & Aviation Education Forum," such topics as "Utilizing the Excitement of Space for Quality Education"; "Space and Aviation Education Panel"; "Utilizing Space Education in the Classroom"; and "The Future Belongs to Who 'Knows to Know'" were discussed. Lists of exhibiting companies, volunteers, attendees, and acronyms are appended. (YP)

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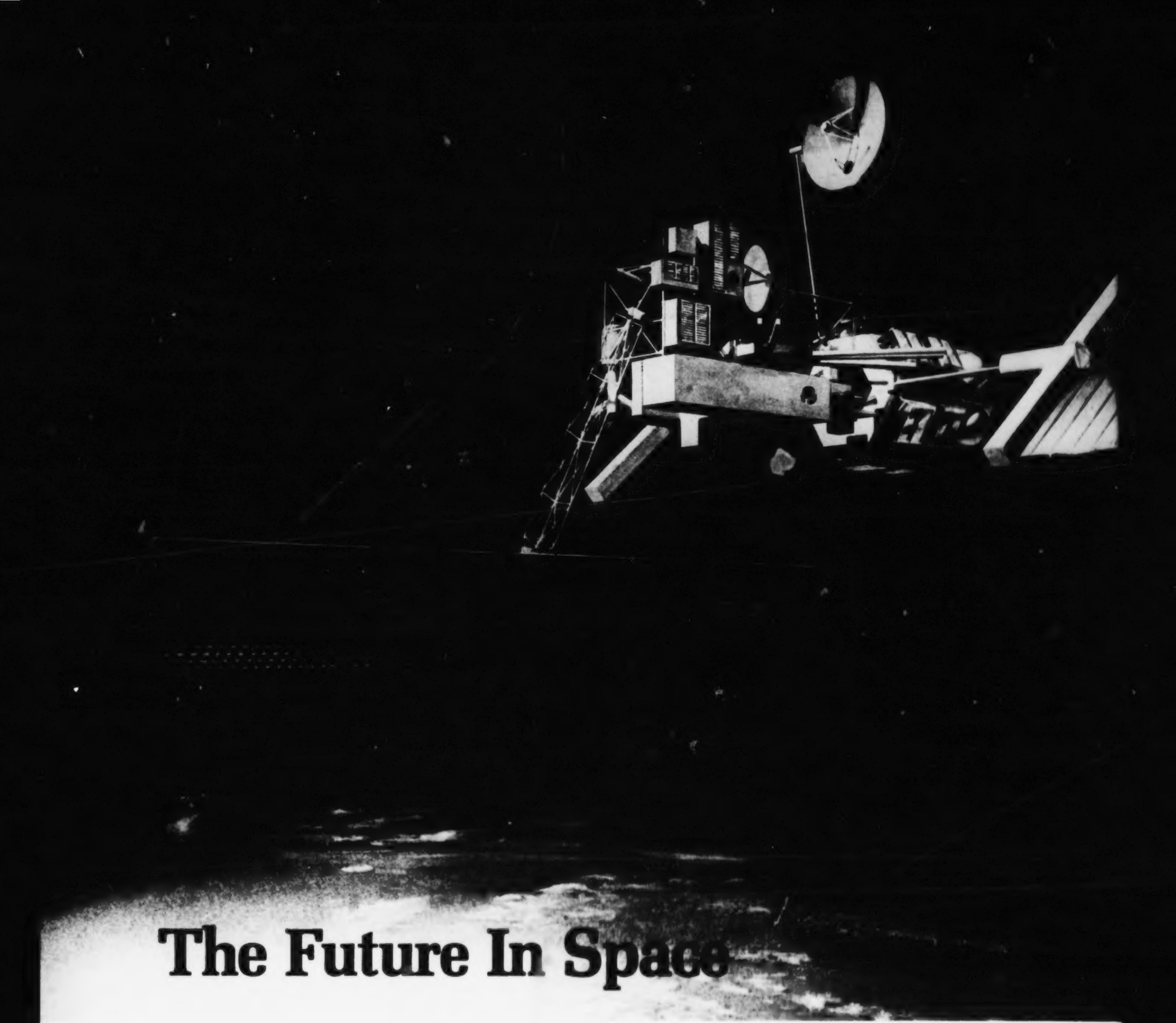

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# FOURTH NATIONAL SPACE SYMPOSIUM PROCEEDINGS REPORT

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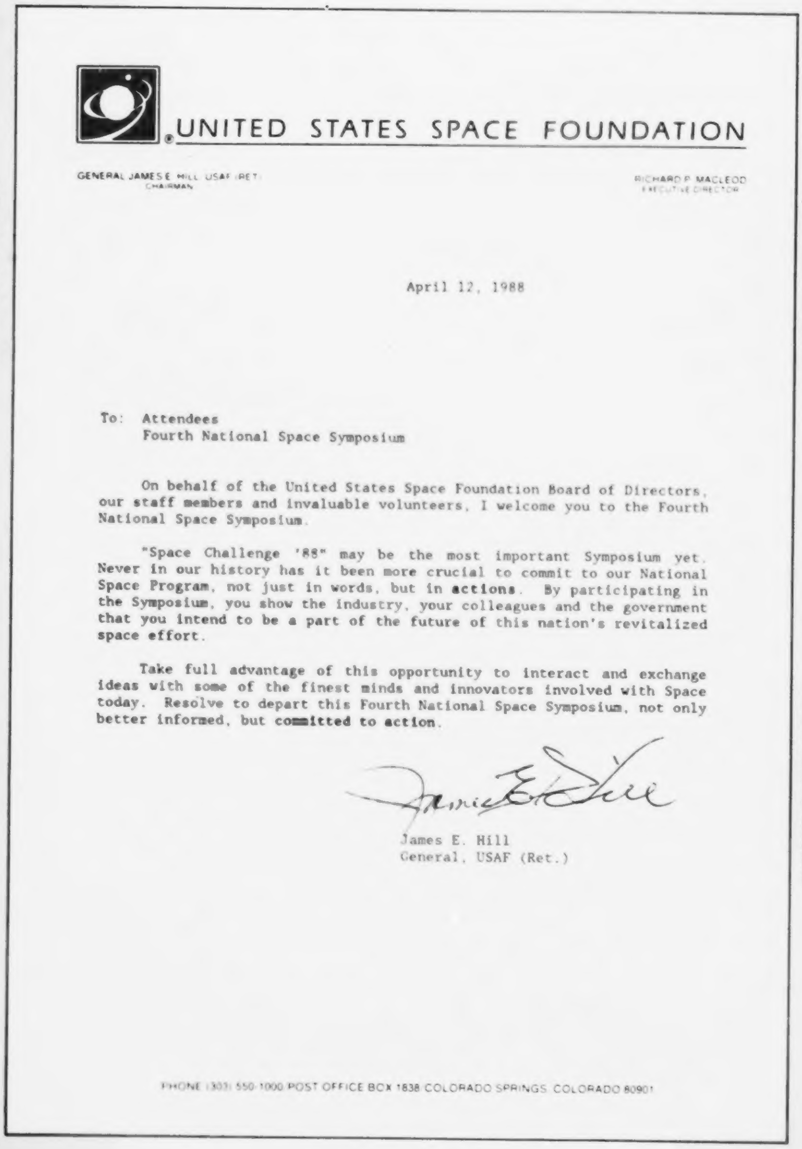

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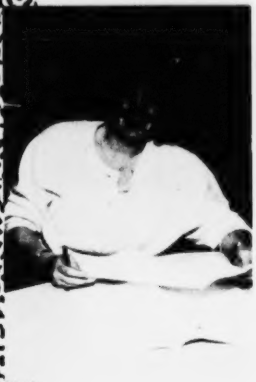
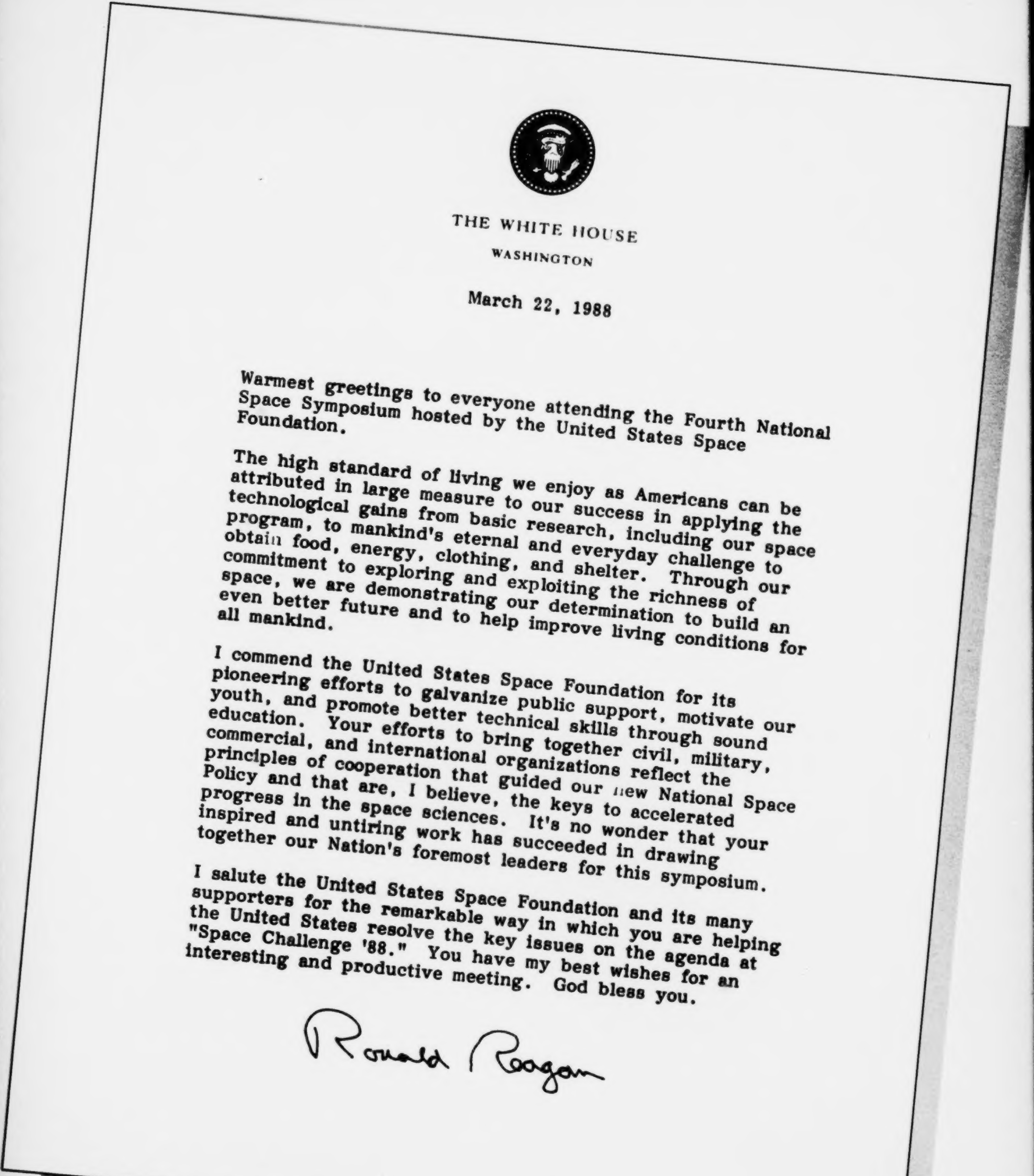




THE WHITE HOUSE
WASHINGTON

March 22, 1988

Warmest greetings to everyone attending the Fourth National Space Symposium hosted by the United States Space Foundation.

The high standard of living we enjoy as Americans can be attributed in large measure to our success in applying the technological gains from basic research, including our space program, to mankind's eternal and everyday challenge to obtain food, energy, clothing, and shelter. Through our commitment to exploring and exploiting the richness of space, we are demonstrating our determination to build an even better future and to help improve living conditions for all mankind.

I commend the United States Space Foundation for its pioneering efforts to galvanize public support, motivate our youth, and promote better technical skills through sound education. Your efforts to bring together civil, military, commercial, and international organizations reflect the principles of cooperation that guided our new National Space Policy and that are, I believe, the keys to accelerated progress in the space sciences. It's no wonder that your inspired and untiring work has succeeded in drawing together our Nation's foremost leaders for this symposium.

I salute the United States Space Foundation and its many supporters for the remarkable way in which you are helping the United States resolve the key issues on the agenda at "Space Challenge '88." You have my best wishes for an interesting and productive meeting. God bless you.

Ronald Reagan

# PROVOCATIVE PERCEPTIONS: SPACE ACHIEVEMENT AND CHALLENGE

*Moderator:* **Dr. Brenda Forman**, Director, International Marketing Policy, Lockheed Corporation

*Speakers:*
**General Sam Phillips**, USAF (Ret.) former Apollo Program Director
**Dr. Carol Rosin**, President, Institute for Security and Cooperation in Outer Space
**Donald E. Fink**, Editor-in Chief, Aviation Week & Space Technology Magazine
**Astronaut Joseph P. Allen,** Executive Vice President, Space Industries, Inc.
**James M. Beggs**, Chairman, Spacehab, Inc. and former NASA Administrator

**MR. MACLEOD:** Good afternoon, ladies and gentlemen. To begin the Fourth National Space Symposium, I would like to introduce the Chairman of the United States Space Foundation, General Jim Hill.

**GEN. HILL:** Thank you. Good afternoon, ladies and gentlemen. It is my pleasure to welcome you to the Fourth National Space Symposium, sponsored by the United States Space Foundation. Dick MacLeod and our staff have worked particularly hard to bring together just the right combination of eminent pro and con speakers to address the key space policy issues we face both within the United States and internationally. The outstanding program we bring today reflects the success of those efforts.

This Symposium marks a pivotal time in the history of the United States Space Programs, civil, military and commercial. That's why this particular program of speakers and your active participation in this vital dialogue are important.

Education lies at the heart of all United States Space Foundation efforts, and the education of our children is a responsibility we take seriously. A computerized educational program called SpaceNet brings space curriculum to teachers in Sidney, Nebraska, from the Foundation's headquarters in Colorado Springs. Teachers will be able to obtain lesson plans, classroom tools and videotapes from the Foundation's Space and Aviation Education Resource Center via the computer.

The Foundation sponsors, with the United States Air Force Academy and the University of Colorado, a number of teacher workshops that have received widespread acclaim. You can help teachers from your area by sponsoring some to attend the workshops here in July.

The progress doesn't stop there. Plans for the future include construction of a Space Foundation museum, library, IMAX theater (shared by the U.S. Olympic Hall of Fame), research and administration facility just northeast of the Colorado Springs airport on land donated by Aries Properties.

The carefully designed Symposium programs bring together space professionals and policy-makers from throughout the world in an atmosphere of commitment and cooperation. The Symposium tradition has brought the Foundation national and international recognition. The late ABC science editor, Jules Bergman, labeled this Symposium "The World Series of Space." President Reagan's new National Space Policy gives a direction long needed for additional civil and military funding, and endeavors to clear obstacles to enhance opportunities for commercial ventures, but well-informed citizens must support the implementation of that kind of policy by the Congress. That's why this summit on space is important.

NASA has thoroughly examined the shuttle program and is confidently looking to resumption of flights this summer, but the increase in funding, particularly for the space station, is in jeopardy. The SDI program is presumed dead by many as of next January 20, when President Reagan leaves office, and you will hear articulate debate Thursday about its prospects.

We believe that if the United States is to continue to progress as a world leader, we must reemphasize our strongest suits. Those are technology development and exploitation, initiated by innovative entrepreneurs applying their skills in a free society.

In his letter welcoming you to this Symposium, President Reagan said, "The high standard of living we enjoy as Americans can be attributed in large measure to our success in applying the technological gains from basic research, including our space program, to mankind's external and everyday challenge to obtain food, energy, clothing and shelter. Through our commitment to exploring and exploiting the richness of space, we are demonstrating our determination to build an even better future and to help improve living conditions for all mankind.

**Let us resolve to reawaken and refuel the vision of a vigorous America led by space achievement**

The President goes on to say, "I commend the United States Space Foundation for its pioneering efforts to galvanize public support, motivate our youth, and promote better technical skills through sound education. Your efforts to bring together civil, military, commercial and international organizations reflect the principles of cooperation that guided our new National Space Policy, and that are, I believe, the keys to accelerated progress in space sciences. It's no wonder that your inspired and untiring work has succeeded in drawing together our Nation's foremost leaders for this Symposium."

So let's get started with Space Challenge '88. Let us resolve to reawaken and refuel the vision of a vigorous America led by space achievement, and I hope you all enjoy this Symposium to its fullest. Thank you.

**MR. MACLEOD:** To start the program today, we introduce the moderator, who will be introducing the speakers this afternoon. This is not a panel. It's intended to be a series of provocative presentations from a number of different perspectives by eminently successful people, and among those the very first to be introduced now is a lady who is well known to the space community, who has been a writer for our "Space Watch" publication for a number of months now, and has probably received more comment than any other author appearing in "Space Watch." Ladies and gentlemen, I present to you now Dr. Brenda Forman.

*DR. BRENDA FORMAN joined the Lockheed Corporation in October of 1983 as Corporate Director, International Marketing Policy. She took her B.A. at Barnard College in New York, and holds a Ph.D. in Political Science from the City University of New York. Dr. Forman came to Lockheed after five years at the Commerce Department, where she was the Director of the Division of Policy Planning in the Office of Export Administration. During her last year at Commerce, she was Senior Technology Policy Advisor under the Assistant Secretary of Commerce for Trade Development. From 1973 to 1979, she was a senior analyst in the Office of the Secretary of Defense, Directorate of Policy Planning, International Security Affairs, where she worked on major policy issues in the areas of security assistance and East-West technology transfer. Earlier, she had spent four years at The MITRE Corporation in Washington, D.C., as a member of the Technical Staff, working on a wide variety of projects for various elements of the Defense Department. She is a member of Phi Beta Kappa and a recipient of the Department of Defense Distinguished Civilian Service Award.*

**DR. FORMAN:** Greetings and welcome everybody. This is going to be a splendid conference. Those of you who have been to the previous ones know what it's going to be like.

If your "in" basket is anything like mine is, you know that space conferences pepper the landscape these days, but this one is the one to go to, not only for the breadth of its subject matter, but for the meatiness of the issues and the caliber of its speakers. This panel is a case in point.

Our theme, as you can see from the program, is "Provocative Perceptions," with the emphasis on provocative.

Humanity is poised on the verge of the greatest frontier that history has ever known. Like the opening of the New World five centuries ago, the opening of the Space Frontier is going to change our world in ways we've only begun to understand, and in countless other ways that we've not even begun to imagine.

**Humanity is poised on the verge of the greatest frontier that history has ever known.**

And as always happens at such times, there are many ideas as to what this new frontier is going to mean to us, what we should or should not do with it, in short, how we should seek to mold its future and thus with it the future of all humanity.

You know, the historical parallels are absolutely fascinating. This really is 1492 all over again. Like the New World five hundred years ago, so the Space Frontier today symbolizes many things to many people. For example, was the New World:

Chiefly the source of gold and natural resources that economic mercantilism theory required? Or:

Was it the pristine site in which the true faith could triumph (however you defined the true faith, Catholicism or Puritanism or any other variant you preferred)? Or:

Was it primarily important as territory to enhance the political power of its European colonizers? Or:

Was it a dumping ground for the "criminal class" of the Old World? Or:

Was it free land and opportunity for the enterprising emigrant?

Similarly, is space today:

Chiefly a place to do business? Or:

Is it an untouched place in which to experiment with new and less hostile ways of conducting international relations? Or:

Is it the highest of all military high grounds, an essential vantage point from which to insure our national security? Or:

Is it something else entirely, something we've hardly yet dreamed of because it's entirely new in our history, to be molded by our aspirations and our dreams — and our mistakes?

I think the answer is: All of the above.

Just as the New World turned out to be all of the things that its discoverers imagined — and a whole lot more they could never have conceived of — so the Space Frontier will startle and amaze us as its history develops.

And I hope that I live long enough to detect some of that history's directions. But in the meantime, we are still peering at its future through many glasses, darkly, which is what our panel today is designed to depict. It's designed to prick your imagination and to nudge your thinking and, hopefully, even to start an argument or six. I think you will not be disappointed.

**Just as the New World turned out to be all of the things that its discoverers imagined...so the Space Frontier will startle and amaze us as its history develops.**

So let me begin by introducing our first panelist.

One of life's more humbling experiences is to moderate a panel like this, because you get to introduce people with credentials so very dazzling as to dwarf your own modest achievements. General Samuel C. Phillips is one of these.

We in this room know Gen. Phillips primarily for his superb work as Director of the Apollo Manned Lunar Landing Program from 1964 to 1969. For his outstanding work on this historic assignment, he was awarded the Air Force Distinguished Service Medal, as well as two — count them, two — NASA Distinguished Service Medals, and the Smithsonian Institution's Langley Medal.

But before he came to the Apollo program, he had had a long and distinguished military record, much decorated during World War II, not only by his own country, which awarded him both the Distinguished Flying Cross and the Air Medal, but also by France, which awarded him the French Croix de Guerre.

After the Apollo program, Gen. Phillips went on to be the Commander of the Air Force Systems Command at Andrews Air Force Base.

He retired from the service in 1975 and then he went on to yet another distinguished career at TRW, from which he retired in 1986.

He is now a private consultant in Palos Verdes, California. He is also a Fellow of the Institute of Electrical and Electronics Engineers, of the American Institute of Aeronautics and Astronautics, and of the American Astronautical Society, and a member of the National Academy of Engineering.

It is my very great pleasure to introduce General Samuel Phillips.

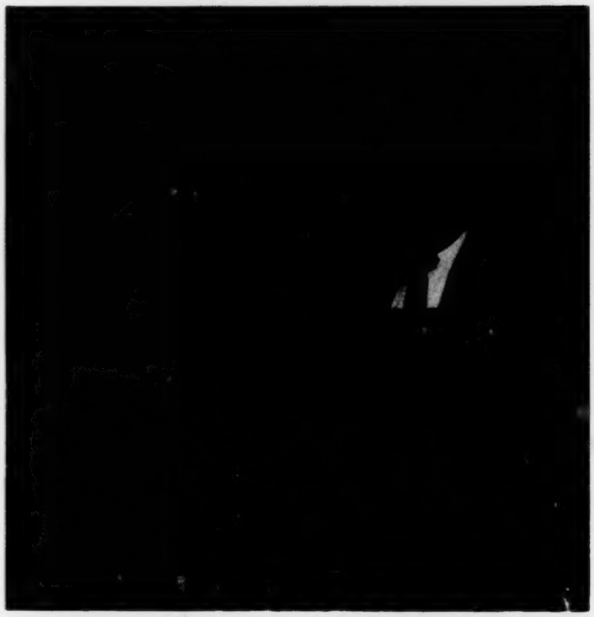
**GEN. PHILLIPS:** Thank you very much, Brenda. Good afternoon, ladies and gentlemen and distinguished guests.

I'm very pleased to be here. I want to thank the United States Space Foundation for asking me to speak. It's a real pleasure to address such a diverse and distinguished international audience.

My major topic today concerns America's place in the international space community and what we can do to retain and enhance our position of leadership. The benefits of the space program to this country and to the rest of the world are simply too great for us to ignore. I will talk about some of those benefits a little bit later, but first let me do a little bit of stage setting.

America's role as an international leader in space exploration has been on hold since January 28th, 1986, the date of the Challenger explosion. The shuttle tragedy, coupled with Titan launch vehicle problems, has crippled our ability to operate in space.

**We've been kidding ourselves for years that we can be the world's pre-eminent nation in space with inadequate budgets and resources.**



*SAMUEL C. PHILLIPS is retired Vice President of TRW Defense Systems. He joined TRW in 1975 as a vice president of TRW Systems & Energy and general manager of its Energy Systems Management Division. Mr. Phillips retired as a General of the U.S. Air Force in September, 1975, following a distinguished career of over 33 years. His assignments included Commander, Air Force Systems Command; Director, National Security Agency/Chief Central Security Service; Commander of SAMSO/Air Force Systems Command; Director of the Apollo Manned Lunar Landing program for NASA; and the Director of the Minuteman Intercontinental Ballistic Missile Program. He received his B.S. from the Univer-*

*sity of Wyoming and his M.S. in Electrical Engineering from the University of Michigan. Gen. Phillips holds an honorary LL.D. from the University of Wyoming and was awarded the Smithsonian Institute's Langley Medal for his contributions to the Apollo Manned Space Program.*

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I have spent much of my time, over the last two years, trying to help the National Aeronautics and Space Administration get back on the right track. I have been working on NASA's management processes and their organizational structure, and I have also been looking hard at NASA's position in the federal bureaucracy.

This study has led me to one inescapable conclusion: This country has been trying for years to do the impossible. We've been trying to maintain our leadership in space on the cheap. We've been kidding ourselves for years that we can be the world's pre-eminent nation in space with inadequate budgets and resources.

I have seen the results of that misguided thinking in the erosion of NASA's organization, its people, and its ability to manage programs; I have seen an erosion in NASA's relationship with its contractors and erosion in resources for key programs. And worse yet, I have seen the fatigue and the frustration on the faces of a lot of very good people who are breaking their backs to do a good job without adequate resources. It's discouraging, to say the least.

America's Space Program has entered a good news/bad news phase. The good news is that the shuttle will fly again, probably in August, and the President has finally articulated a National Space Policy and a budget to match. The bad news — and I think it is bad news — is that unless our nation's leaders get their act together quickly, it may be too late for the United States to regain its leadership in space.

**We now have a chance to reassert our prowess as a space-faring nation. President Reagan's National Space Policy outlines a way to capture the high ground.**

I think the United States has taken a myopic view of space — one that would shame Mr. Magoo — almost since the Apollo 11 astronauts touched down on the moon in 1969. The shuttle notwithstanding, nearly 20 years have gone by since this country demonstrated a clear-cut commitment to its Space Program. I think that kind of neglect, for an effort so important to our place in the world community, is impossible to justify. What's been needed for a long time is a sense of vision.

We now have a chance to reassert our prowess as a space-faring nation. President Reagan's National Space Policy outlines a way to capture the high ground.

Among other things, it calls for expanding human presence beyond earth orbit; it establishes a basis to develop technologies that are vital to both manned and unmanned space exploration; it provides a framework to exploit the commercial potential of space; and it sets forth strategies to enhance the national security aspects of our military Space Program.

In short, this policy represents an investment in the future, and evokes an adventurous spirit that's been missing far too long.

However, I am worried about the impact that the erosion of our space leadership may have on the United States in terms of its place in the world community.

Our national leaders must make the Space Program an integral part of our national objectives, set realistic goals, and finally, gain the political support and assemble the resources that are necessary to carry out those goals.

I believe history bears out this formula for success. I saw it first-hand back in the '60s when I had the opportunity to manage the Apollo program. It was one of the most challenging and also rewarding periods of my life.

**Our national leaders must make the Space Program an integral part of our national objectives, set realistic goals, and finally, gain the political support and assemble the resources that are necessary to carry out those goals.**

As we all know, the Apollo program was established to achieve the national goal set in 1961 by President Kennedy to land astronauts on the moon by the end of the '60s.

That goal instantly became a part of our national objectives. The President, the Congress, and ultimately the American people were willing to accept this hugely ambitious and tremendously expensive program because it met a pressing national need.

Apollo had its share of setbacks, most notably the disastrous launch-pad fire in 1967 that killed Astronauts Gus Grissom, Roger Chaffee and Ed White. And at that time as now, with the Challenger accident, there was a lot of soul-searching about whether we should continue the program.

Fortunately, NASA's aggressive, savvy leadership carried the day, and support was maintained throughout the Johnson administration and into the early Nixon administration. Without this continued commitment, we could never have achieved a lunar landing by 1969.

Landing astronauts on the moon and returning them safely to earth required new technologies and major extensions of existing technology. We had to create a totally new system. We had to organize sophisticated programs to train people. We had to test their skills and instill discipline, and all the while, we were working against an end-of-the-decade deadline.

Yet Apollo, unlike any space program before or since, demonstrated the power of our Space Program to influence world thinking.

Think back for a minute to the flight of Apollo 8, the one in 1968 when Frank Borman and his crew read a Christmas message as they circled the moon. A significant portion of the world's population was riveted on that moment.

The same thing happened, only on a much larger scale, in July of 1969, when Neil Armstrong and Buzz Aldrin — who is here with us today — touched down on the lunar surface. The moon landing focused the attention of the world's people during one of this century's most turbulent decades.

Apollo was a triumph of technology and innovation. More importantly, it demonstrated the power of collective determination, something America's Space Program hasn't been able to recapture with the same intensity since.

Let's look at some of the lessons we learned from the Apollo program. I think they're applicable to any spacefaring nation, and well worth considering in light of today's space objectives.

First, Apollo received strong support at the top. Our national leaders were willing to stand behind the program and secure the necessary funding to achieve its objective. That kind of commitment is absolutely essential to any major space endeavor.

**Apollo was a triumph of technology and innovation. More importantly, it demonstrated the power of collective determination, something America's Space Program hasn't been able to recapture with the same intensity since.**

Second, the program organization on the government side was professionally competent. Apollo drew its technical expertise largely from the NASA centers. But it also relied heavily on system engineering contractors, industrial contractors, the scientific and academic communities, and people on loan from the Department of Defense.

Third, Apollo was a model of realistic budgeting. By doing its homework, the Apollo team was able to explain and defend its budget within the executive departments, including the Office of Management and Budget, and to cognizant Congressional committees.

The principal Congressional committees had confidence in us because we were credible. Make no mistake, those committees weren't pushovers. They worked us over very thoroughly. But they understood that we had a job to do and they gave us the resources to do it. As a result, the budget was generally approved as submitted, which is a rarity in today's environment.

I think the point here is that honesty is essential. Presenting low or inaccurate cost estimates, either to demonstrate a potential cost- efficiency or to gain approval for a particular program, creates public and Congressional mistrust. And it ultimately makes political support very difficult to obtain.

Fourth, the Apollo program, and the rest of the Space Program for that matter, strived to develop a positive relationship between government and industry — again, something we don't see much of today. We built and maintained a strong team of government, industry, scientific and academic institutions that were committed to the program.

Fifth, the channels of review and approval were streamlined to a remarkable degree — another present-day rarity. Apollo operated along relatively simple organizational lines with direct channels of review and approval. I doubt if we could have succeeded otherwise.

Yet succeed we did. And we reaped scientific and technological benefits that have influenced this nation's and other nations' space programs ever since.

And that brings me to my next point: The benefits that we as a people derive from the Space Program.

One of the major benefits is that the Space Program gives impetus for nations to engage in risky, leading-edge technology developments. Space research and development was responsible for moving broad areas of science and technology forward. You know many of them, but I will cite a few:

Today's communications revolution has been fueled, in large part, by the tremendous strides in satellite communications technology. COMSATs have brought international color television into our homes; they have made long-distance telephone calls affordable for nearly everyone; and they've provided access to almost limitless amounts of information instantly.

Major advances have taken place in electronics, computer systems, and computer software as a result of systems that were developed for our Space Programs. We've reaped the rewards in countless ways, from computers that run our businesses to systems that help us do our banking, check our medical records, and help our children learn.

We have seen major developments in strong, lightweight materials that have grown out of our space work. These materials help make cars and airplanes safer and more fuel-efficient, and they make machinery and appliances more durable.

In addition to technical advances, space resources play a vital role in maintaining national security. The United States and the Soviet Union and other nations rely on military spacecraft to help protect their national interests.

**The Space Program is a creator, rather than just a consumer of financial resources.**

Another major benefit is in the area of economics and job creation. The Space Program creates capabilities, such as technologies and jobs, which, in turn, create growth and create wealth. Or, to put it another way, the Space Program is a creator, rather than just a consumer of financial resources. I think we need to base our investments in space with that understanding in mind.

Of course, there's always the argument about funding for space versus funding for social programs. It's a continuing tug of war, but let me give you my perspective on that issue.

Back in the 1960s, some Congressional leaders argued in favor of cutting NASA's budget and shifting funds to pay for The Great Society's social programs. That logic was as unsound then as it is now. The fact is that the diverted funds don't reach social programs, no matter how worthy they are. But I think that besides that, the benefits from the Space Program are proportionately much greater than from many social programs.

Now don't get me wrong. I believe we should help people who can't help themselves. That's not an issue with me. But many social programs are really only short-term solutions to greater problems, such as unemployment, underemployment, or lack of adequate education and training.

I have said the Space Program is a long-term investment. It's one that produces jobs, many of them in high technology and high growth areas, such as in electronics and computers. These jobs often lead to training programs that upgrade skills and create even better jobs. So the investment in space produces paybacks that are long lasting and far reaching.

An equally important dimension of the Space Program's value is its impact on the world scene. The Space Program is very much an instrument of national policy in international affairs. The competition between the United States and the Soviet Union in space has expanded both nations' technological frontiers.

The Soviets, I think, understand or demonstrate that they understand, this concept of space-as-a-national-policy much better than we've demonstrated that we understand it. They've seen how important space is to their standing in the world community and they've invested accordingly.

You need only look at the number of space launches they make each year (about 95 in 1987), their successful MIR space station and their ambitious plans for an unmanned Mars landing in the early '90s, to realize their total commitment to a viable space program.

Now, contrast that to what the United States has been doing since the Apollo 11 astronauts returned from the moon almost 19 years ago.

Shortly after Apollo 11, I said that we should make a major commitment to carry out a manned mission to Mars. I realized that the Mars mission would pose unprecedented technical challenges. But I believed, and still believe, that the cost would be consistent with our national resources and the benefits to our nation would far outweigh the costs and the risks that are involved.

A Mars landing drew little support at the time, although it appears to have more support now. Instead, America proceeded with the shuttle program, which was considered the next logical step that would make a space station and future manned planetary missions possible.

I'm convinced that if we had committed to a Mars mission in 1969 with the same kind of determination and support that we gave the Apollo program, we currently would be in the final stages of a Mars voyage, rather than being 20 years away as we still are.

What's more, I believe that the United States committed a major strategic error in justifying the space shuttle on the basis of economic, rather than scientific and other operational development kinds of paybacks. The shuttle should have been seen as a way to enhance man's ability to operate in space, rather than as being viewed as the only way to get into space and the most economical way to carry cargo, launch satellites, or build a space station. That just isn't the way the shuttle has developed.

By relying on the space shuttle solely, at the expense of developing a fleet of expendable launch vehicles, America has created a potentially disastrous launch crisis. I'm glad to see that we're finally taking steps to develop a mixed fleet of shuttles and expendable launch vehicles.

Unfortunately, I think we're making some of the same mistakes with the space station. We're trying to justify it too much on the basis of its ability to manufacture exotic materials, drugs, or super-round ball bearings. Instead, I think we must view the space station for what it is: a way for man to operate in space, and to learn how to operate in space for extended periods, a way to extend man's presence beyond earth orbit. And having done that, then we can turn to economic payoffs, but I don't think we ought to do it the other way around.

**By relying on the space shuttle solely, at the expense of developing a fleet of expendable launch vehicles, America has created a potentially disastrous launch crisis.**

To me it's clear, then, that the Space Program is vital to our national interests — technological, political and economic. It offers a broad range of benefits. And, under the right circumstances, it is eminently manageable.

If we can decide what we want to do, we have the competent people available to do it. So the issue comes down to doing what's necessary to obtain the direction, the priorities, and the continuity of commitment to get the Space Program moving again.

Briefly, let me outline some possible solutions.

The first thing that's needed is a clear, coherent top-level vision of what the Space Program should be. The President must articulate that vision to the Congress, the press, and the American people. Such a commitment should be made early so that the continuity of support can be generated.

But the President can't function in a vacuum. The President must have informed advice. What's needed is a dedicated organization to develop a national space policy independent of special interests.

I favor, as does the National Commission on Space, the Paine Commission, and the American Institute of Aeronautics and Astronautics, reinstitution of the National Aeronautics and Space Council, first conceived under the Eisenhower administration. The Council set policy for both the civil and the military space programs.

Today's structure of having a senior inter-agency group for space, called SIG-Space, under the National Security Council, in my judgment, is badly flawed. SIG-Space simply isn't adequate to define U.S. space needs and to formulate coherent policy.

Next, the review and approval process must be streamlined. Congress, the President, and NASA must work together to eliminate the miles of red tape that make the funding and acquisition process so cumbersome.

Worse yet, the prosecutorial mentality born of Watergate and accelerated by the Iran-Contra affair, has created an avalanche of rules, regulations, and negative headlines, which, in turn, have generated a fear of action, a gridlock to progress, and a stalemate for getting things done.

We must work harder to reduce the adversarial relationship that exists among Congress, federal agencies and industry. We're already seeing progress on that front from various industry organizations, and the expressed willingness of the industry to work with the Government.

The Space Agency, in concert with industry and Congress, should mount a broad communications campaign to sell the program to the American taxpayer, who must ultimately foot the bill. Communications ought to stress the vital nature of the program and its objectives, and its importance to the nation. Despite the current cynicism about the Space Program, I'm convinced that the right program, clearly voiced, would practically sell itself.

Finally, we must develop a team of the best people possible to do the job. And that shouldn't be too hard. The early Space Program had little difficulty attracting top technical and managerial talent, and with the right incentives, not necessarily money, we can do the same thing again today.

**I'm convinced that the right program, clearly voiced, would practically sell itself.**

But above all, we must take action. We don't need another big study. We've had the Paine Commission Report and the Ride study. We know what needs to be done. It's absolutely essential that we start the decision-making and consensus-building now.

Right now, the hard part is determining how much of our national energy and resources to commit to space exploration. That requires that we first decide, as a nation, what we want to do next — and to what extent we want to include other nations in that decision-making process. This decision is critical, for it will establish our place in the hierarchy of space-faring nations for a long time to come.

The United States needs to approach international involvement in space with great care and clarity of purpose. Once we've committed to a space goal that involves other nations, we need to do a better job of making sure, as a matter of national policy, that there is stability and continuity of commitment.

We must set realistic objectives and be a reliable partner to our international space colleagues. I'm convinced that strong partnerships will pay off handsomely for all participants.

The Space Program is unique in human history. It's big enough for those nations that wish to participate. Right now, I'm eager for the United States to move out with an aggressive space program. I think it's critical to our standing in the world community.

Thank you very much.

**DR. FORMAN:** Thank you, Gen. Phillips, for that cogent and stirring exhortation of action. Remember, a lot of this is up to us, and it's all very well and good for us to sit in this room and say, "Boy, that's right," but if we don't go out and talk it over with our friends, our acquaintances and our Congressmen, it won't go any further than this room.

Our next panelist is Dr. Carol Rosin, and she is no stranger to this Symposium, having been a speaker at each of its sessions to date, I believe. Those of you who have heard her will recall the passion and intensity she brings to her subject. Hers is truly a provocative perspective in keeping with the theme of this panel.

She's a very accomplished woman. She's the President and the Founder of the Institute for Security and Cooperation in Outer Space, which she describes as "an activist educational think-tank dedicated to promoting a new way of thinking about ways to develop the Space Frontier by cooperation rather than confrontation, and without deploying space-based weapons."

She was also formerly a corporate manager at Fairchild Industries, and has since been a consultant to such major space defense firms as IBM, GE and TRW, where she worked on the MX missile and defense strategy.

She hosts the cable TV show,"Peace Works," and recently has co-authored a book with Dr. Charles Sheffield, entitled **Space Careers.** She's now co-authoring another book with Apollo astronaut Dr. Edgar Mitchell on the SDI and alternatives.

It's my pleasure to introduce Dr. Carol Rosin.

*DR. CAROL ROSIN is President and Founder of the Institute for Security and Cooperation in Outer Space, a D.C.-based think tank/educational organization with an action component (501-c-3). She was formerly a Corporate Manager of Fairchild Industries, and is a space and missile defense consultant. She has worked for such companies as TRW, GE and IBM, and is an international speaker. She has worked with the grass roots, the CIA, Department of Agriculture, military space planners, and many organizations. Co-author of SPACE CAREERS with Dr. Charles Sheffield, and co-author of a forthcoming book with Apollo astronaut Dr. Edgar Mitchell, she is working on THIS IS YOUR...-...WAKE-UP CALL. Rosin is author of numerous papers and articles. She is hosting a cable t.v. show called PEACEWORKS. Rosin is regarded as the original political architect of the move to stop the SDI and ASATS.*

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**DR. ROSIN:** I would like to thank my mother, my father, my husband, and the U.S. Space Foundation — Dick MacLeod, especially, Gen. Hill, for inviting me back again to give my annual update, and to a new way of thinking this year. Some of you may remember a very passionate dramatic kind of hysterical speech when I first spoke here, when I asked "isn't anybody thinking about space weapons?" I felt that what some people were saying about the U.S. Space Foundation, that it's a "front" for the SDI may be true. As I met everybody, the USSF seemed to be a wonderful, intelligent, fair forum for discussing great new ideas.

That's what I want to do today: discuss new ideas and happenings. I would like to trip off from Dr. Forman's talk, and her thoughtful questions, from Gen. Hill's introduction and from Gen. Sam Phillip's in-depth discussion on the new commitment that we need and the erosion that we're experiencing. In a framework that includes the 3 T's, time, truth, and trends, I would like to discuss some new trends in the form of a new context of international, military, civilian, and commercial space cooperation. I hope that as we go through the next few days in this conference that we will listen very hard to the speakers for the context in which they're presenting their material. Is it being presented in the context of rapidly improving US/Soviet relations, which I hope we'll all catch on to? I'll present in "accelerated time," so please stick with me, as I give you some data dumps.

As I was driving to the airport to come here, my husband was telling me about what he just heard on national public radio on the news about Mr. Gorbachev saying that the Soviets are pulling out of Afghanistan, that Shultz was on his way to Geneva to make sure that that agreement takes place, and that Gorbachev is telling Arafat that he has to recognize Israel, and about Federal Express Mail going into the Soviet Union. All in one newscast! Also that President Reagan soon will be standing in Red Square, and about his support for pushing cultural events.

Times are changing! There's something incredible happening. Change is constant. "Change" is what we need to be preparing for as we move forward.

At the U.S. Space Foundation conference, we're going to be hearing a lot of speeches that are logical, based on scientific method. There's a whole other way of thinking that's based on another kind of logic; intuition and new kinds of actions that are going on.

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**Times are changing! There's something incredible happening. Change is constant. "Change" is what we need to be preparing for as we move forward.**

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Over the last year, knowing I was coming here, I spent extra time collecting facts, exploring last year in what appears to be almost another world, except that it's our world, and we're very much a part of it.

One thing before we go into it, I would like for us to take time during this conference to think deeper, to come from a "heart" place, to look into our hearts for the truth about what our motives and intentions are. What are we looking for? Money? Adventure? Security? Probably all of the above. Are we seeking communion? Communication? If so, what doors are we not opening as widely as we could?

I was talking with scientist John Lilly. The dolphin communication experiments on which he's been working had to stop; he had to stop them, because he was so afraid that the communication information we're getting from the dolphins might be applied to — pardon me, Navy — some Navy strategies that he thought might be destructive, that would likely head us into a dangerous direction for the planet. He wants it to be applied to raising our higher consciousness to educating people. It was a sad discussion, and it led to my observation of the earth's systems that we see breaking down. Protests, revolutions and suffering are taking place all over the planet. What are we doing? What is missing? Will it be too late when we change our ways? The biggest question after we wake up is "What can I/we do?"

If we dig for the deep truth, I think each of us knows the answer. The first of my two part presentation will be on the SDI, and the second on the Age of Cooperation. I'm going to talk about the SDI very briefly this year, because, I think the handwriting is on the wall. It's just a matter of who's willing to say it...to tell the truth.

There seems to be a very slow death of the SDI occurring, maybe it will be more quickly after the next presidential election. In any case, it's pretty clear to me the facts are out. The protests exist; if you want to hear about the first strike, you invite Dr. Michio Kaku, who will tell you how to have your own nuclear war, or a lot of speakers. We had Richard Garwin speak last year. There's a major protest Michio Kaku has put together with almost 10,000 scientists, engineers, physicists, who refuse to work on the SDI. You and I know that the SDI has some great research in it. I want to be clear that we don't have to stop that same research; just stop the space-based weapons technology "intention" of it, and stop that whole mentality. It's time!

We've answered President Reagan's questions. We can't defend ourselves from ICBMs, not with space-based weapons. It's not cost effective during the times of our deficit, debts, and economic crunch. It's threatening, destabilizing! The Soviets perceive it as first strike, and therefore it is a first strike system. It has cheap countermeasures.

**We can't defend ourselves from ICBMs, not with space-based weapons. It's not cost effective during the times of our deficit, debts, and economic crunch.**

Some lobbyists and others oppose the SDI, but support various levels of funding R&D of space weapons. They tell me it's to look "credible" and "politically effective," or to "hedge the Soviets". None of these are acceptable reasons when we have a better choice. New legislation is coming out. Senator Tom Harkin and others are introducing legislation to ban weapons from space. The Soviets have agreed to sign a verifiable ban, and to work with us. It's all forthcoming. Peace is coming if we work for it.

Why are we continuing SDI? Are we acting out of fear, because we're afraid of the Soviets? Because they're coming to get us? Or because they're taking over the world? Are we still thinking this way? There is some realism to that, of course, but, there's a whole new thinking that's based on new behavior. I hope these facts will dispel a lot of the fear-based myths. Are you afraid they might "break out?" That we need to "hedge them?" Well, in fact, if we are cooperating on R&D with them, we're going to (and already do!) know what they're doing. We are cooperating with the Soviets. We do know what they're doing! Are we doing it because we need the funds? I hear a lot of that. "The only way I can get the funding for my widgets is to participate in the SDI program. I don't believe in it, I don't want it," so many say. When I say SDI, I mean the space weapons parts of it. The SDI Program is geared to put weapons in space, defensive or offensive, whatever you want to call it. It's the "old game," not the new one. Do you believe the human species is aggressive? That we have to gain the high frontier with weapons? That's the old way of thinking. I want to meet the people here who are waking up - who are seeing alternative approaches.

Our intentions may be good, to provide security to our planet, to our country. Our intentions may not be appropriate for our time, however, if they are aimed at gaining dominance, superiority. If you study conflict resolution techniques, you'll learn that this approach isn't the best. What works is talking about cooperation, sharing, love, not dominance. Have you heard of the Morgan Papers? They show that our constitution was not based on, as we thought, the cradle of civilization, Great Britain, Italy, France; it was based on the Iroquois original constitution, the Indians, and one major part was left out, the balance, the balance to the dominance: women. The women of the land were allowed to elect the leaders, or impeach them, if after three warnings, they didn't do things for the best of the people. The existence and need for balance is growing. Out of the "old game," a new game is emerging that can provide the balance we need to survive. The SDI fits in the old game, the game based on fears, threats, intimidation, uncertainty, isolation, separateness, confrontation, keeping secrets, hatred, lack of trust. If we're playing that game, it fits.

**Our intentions may be good, to provide security to our planet, to our country. Our intentions may not be appropriate for our time, however, if they are aimed at gaining dominance, superiority.**

If we're moving into the new game, which we are, then we talk and act in the context of cooperation, compassion, understanding, working together, cooperation certainty, sharing of information, openness, building trust, even loving the people in the Soviet Union and the leaders. Then the SDI is not the game that would give us balance, because it stimulates fears and threats. The worst part to me of the space weapons idea, is that it's draining our resources, our economy; it's draining our country, including the whole vast amount of human resources, and almost all of our energy. This country is focusing on an area in which the rest of the world, even though some countries or industries are participating in the SDI, are moving on. Once again, in another field of technology, you can observe, we are falling behind on the global level. A global economy and security system is forming.

> **If we're moving into the new game,...then we talk and act in the context of cooperation, compassion, understanding, working together, cooperation certainty, sharing of information, openness, building trust,**

The General, and I'm sure many others during this conference, will talk about how we're falling behind the momentum that's moving on in the world to explore space. I would like to add that the U.S. is responsible for the momentum towards space weapons. Space weapons funding could squeak by, if we're not really tuned in, and throw the U.S. backwards as the rest of the world isn't headed that way. We could choose, however, to focus on a way of thinking. This is where I'm going to put most of my time and I'll speed up now.

We need to start thinking about a long range perspective, including 50 or 100, 500, 5,000, 10,000 years ahead. What do we want to see in our space? There's so much evidence that's proving the future is not going to be like the past. Jesse Jackson, who wants a Space Development Initiative instead of a Strategic Defense Initiative, could become President. There's a new vision and we can create the reality. We need a new vision for space, but there's a new vision of Ghia; and it's based on the world "working." It's based on our garden expanding, breathing and growing; on the people and the planet being protected and preserved.

I've looked into "networking." Who are the people that are creating this change, this positive vision of the world working; the east and west, north and south, together, as one humanity? (Sound naive? I think it's naive to think we're going to proceed to escalate the arms race with space weapons.) I believe networking (communication) can create whatever we want. This is what's going on: the book, **The Aquarian Conspiracy** by Marilyn Ferguson discusses a leaderless, but powerful network of people in the United States working for "change." It's an incredible idea, and it's going on! Peacenet; there are 2,000 people on a peace communications network, within 35 countries. The San Francisco/Moscow Teleport, we're live, uncensored on-line computer conferencing with the Soviet Union.

From your home you can talk to your Soviet friends in their home in Moscow: live, uncensored. Yveni Velikov (I hope he will be able to come one year) wrote a huge full-paged newspaper article on how computers will be valuable to Soviet homes and schools. Now they're moving computers right in there. I have been communicating on a computer to someone's home for the last four or five years, but now it's becoming public knowledge, and individuals, academies, businesses, major groups and institutes are on-line.

Space bridges, produced with slow scan technology are relatively inexpensive. We could have a tool of technology in this room, where you could link up by telephone satellites and see a picture of next year's Soviet speaker, talking with live audio and still picture exchanges with the Soviet Union.

Teleconferences — I just participated in one with 500 college campuses in Australia and Canada and the U.S. Students were speaking live, and had questions and answers with "votes" appear on the screen within minutes of each other. Votes, we can vote via satellite. The five continents are linked up. The U.S.S.R. has participated in lots of teleconferences. They have Red Cross type of disaster training programs going on, like what we experienced during the Application Technology Satellite-6 (ATS-6) with Veteran Administration hospital doctors and nurses receiving training. There are conferences going on all over the country and the world on everything, from holistic health to global concerns. Satellites are networking people around the world, Soviet and Eastern Bloc included, through "citizen diplomacy." "Citizen diplomacy" has been documented. There are ways to reach people in Moscow, and soon I'll show you a Moscow telephone book. Here's a resource book of addresses and phone numbers plus more. This one is mostly organizations. The personal one's being developed. "Keeping the peace when it matters too much to be left to the politicians." It's an amazing concept.

I first met a man named Jim Hickman years ago, the first person to explain to me how people like us are making change in government. At first, "citizen diplomacy" seemed kind of flaky to some; strange for individual citizens not representing a government or an institution even, to go to the Soviet Union and then to make things happen. The first thing I saw happen was a live audio-visual satellite conference between LA and Moscow students. Jim Hickman is in the Soviet Union right now, working on a deal to melt down missiles, or the weapons that we're going to be getting rid of, to turn them into desk-top plow-shares. He's with our Colorado friend John Denver. Many of us know that John wants to go up into space. It seems that may be coming to fruition on the MIR Soviet space station. They're there talking about it.

We have Entertainment Summits, the Soviets will give us half the money to produce almost anything we want to do regarding space; films, documentaries, books, theatre. There's an organization called FUN, Friends of the United Nations, who educate people about the United Nations - an organization which we could work closer with to R&D space; the Parliamentarians for Global Action are producing team reports on verification and on test-ban techniques. I have helped work with them on on-site launch inspection, which are used in "high level circles." The Soviets have agreed to major change in strategy that is taking place...much of which has been encouraged by the Soviet "citizen diplomats.

I went to the U.S./Soviet citizens Summit meeting in Virginia, where 400 Americans met with 100 Soviets in February. I worked with two of the cosmonauts, Georgi Grechko, who has been in space three times, and Svetlana, a woman cosmonaut, and with a team of people, including Dr. Brian O'Leary, the astronaut who wrote **Mars 1999, Cooperative Soviet and U.S. World Ventures**. We developed a huge list of cooperative space ventures, near and long term. See if you identify with any of these or may want to work on them with the Soviets.

**NEAR TERM ACTIVITIES ON EARTH:** International Space Year; IMAX film, Cooperation in Space; Joint space museum project; Telecommunications via satellite programs; Cross-cultural research and training program; Cosmonaut-Astronaut exchanges/ lectures; Education project using micro-computers; Cooperative Publications-theoretical, practical, science, popular, art, etc.; Brief world leaders about peace/space issues; TV cinema films for space-documentary, art, popular; Space for Third World projects, meetings, etc.; Bio-cosmology joint studies, how we eat what, in relation to our position; Universal laws and principles; Search for extraterrestrial intelligence; Answers to world energy and food problems YIA space; Space amusement parks.

**NEAR TERM ACTIVITIES IN SPACE:** Commercial Space Ventures (including barter, e.g. Art Dula and Commercial Space Inc.); Internationally shared space based research; Crew exchanges in space - government and non-government; International Technical Project; Project of Biotechnology Module to be expanded; Robot to Mars - "Mars Rover".

**INTERNATIONAL HUMAN MISSIONS TO DEEP SPACE:** Joint US/USSR manned (peopled) Mars mission in about 2000; Lunar base; Mars base; Tourism; Solar power satellites; Colonies/stations; Asteroid mining; Advanced technical propulsion development; 21st century renaissance projects.

**EARTH SPACE INITIATIVES:** World Space Organization for cooperation, understanding and planetary peace; International satellite system to support and verify disarmament and to solve global problems; Converting weapons production to peaceful space projects; reallocating jobs, training programs, and resources.

**The Soviets are opening. Glasnos - Glavcosmos**

There's an explosion of US/Soviet exchanges going on. In January, an agreement was signed to study everything from AIDS to nuclear safety reactors. (Edward Teller has been working on that too.) NASA and the environmental experts have been doing a lot of projects together. The National Institute of Health did a space bridge with the Soviet Union, and it was remarkable; 3,500 U.S. hospitals and U.S.S.R. hospitals, along with hospitals in Europe and the Middle East participated, talking about cancer, how to solve it, with the latest research and the best experts. It was amazing. There's a "humor exchange" — a lot of what we do is so serious. It's building an atmosphere for us to create our cooperative space ventures, including educational, music, and art exchanges. There are more people learning Russian in this country now than ever before. Visa-wise, the Soviets allowed in nearly 100,000 Americans to visit the USSR in 1987. That was twice as many as in 1986, and we allowed twice as many of the Soviets, about 12,000 in this country in '87, and that should double again this year. The Soviets are opening. Glasnos - Glavcosmos!

Now, we're talking about developing a new kind of security system, a new definition of security. We've talked about security mostly based on preparation for disasters and wars. I believe we're going to have security, based on information sharing and on cooperation. There's literally a new definition of security and defense emerging. I'm a bit controversial in the peace movement because I support the military. To me, the military has been forging the frontier without weapons in space. The military has all the answers, the tools, and the technology right here in Colorado Springs, but you need to educate people about what you will do when the Soviet threat is over. I hosted a "Peaceworks" cable TV show with Col. Stan Rosen, who may be here. It was wonderful. I will be glad to share the videotape with you to show you how peace groups suddenly saw what the military is doing of a non-weapons nature - the new role for providing security and solutions to the problems in the planet, for the defense industry, and the military.

Today's challenge is to find a win/win situation, where we all fit. I have not only not fit in the peace groups on occasion; I have not fit here, because there are people who thought I worked for the KGB; somebody else thinks I worked for the military-industrial complex. I have seen my name written in terms of working for the CIA, the KGB, and others, depending on the group's fear factor.

The fact is we are all working together, and all of us "fit" including the Communists, the Soviets, the Eastern Bloc, and the rest of the world. It's not so much a matter, in my opinion, of how we're going to fit the rest of the world into "our" program, we need to start looking at how we're going to fit into the world's program, if we want to maintain a leadership role and base it on cooperation.

Brave, I call him; Mr. Gorbachev has now not only accepted on-site launch inspection verification, but a total comprehensive verifiable ban on space weapons and has agreed to, as you know, lists of cooperative space ventures. The Center for Defense Information, Admirals LaRogue and Carroll, have held exchanges right in Washington, and retired and active officers/generals meeting in July, talking about a new kind of security system.

Major Gen. Jack Kidd, who has a book called the **Strategic Cooperation Initiative** on the Starlight Strategy for reducing weapons, has been to the Soviet Union talking about cooperative security measures. The ISCOS newsletter, focusing on how the defense and military industry is developing our new security system, our common security system that includes protection from threats of the environment, economics, diseases, starvation: those threats, not the Soviet threat, are among the real threats. How we can work together in a step by step strategy, from Gen. Kidd. Some of you may know General Michail Millstein from the Soviet Union who has been on a lot of these exchanges. He was at the Citizens Summit. I met with him privately, and I asked him if he was serious about getting active officers to sit down and meet together. As you know now, this is on the table as a real possibility. (I've heard high level military officers are planning tours and meetings in the US in July.) Not only is Millstein talking about active officers meeting, but about absolute commitments to be made regarding military to military cooperation. I know of a meeting that just took place last week in Europe, where the European allies were talking about meeting their Soviet military counterparts. Here too, that discussion is taking place in a reality — really exciting stuff — about having military sit down, not only to talk together about strategic matters and what we can do now to form our world security system, but also about having military sports games. They're talking football, baseball, hockey, so there's some fun in store for us in these circles.

There's a book called **Securing Our Planet** that has a lot of papers in it about how this new security system is being developed, but one of the most exciting people, I think, that isn't in that group, but is creating his own chapter, is Les Arnold from Arnold Magnetics, a defense contractor in aerospace. He is in the Soviet Union as we speak. He had the choice of coming here but decided to go there, with about 25 of his personal friends and his mother, to start our process towards defense company chairs and presidents, marketers, going to the Soviet Union. We're going to have a follow-up meeting to this one. Anyone interested, please contact me. We may be leaving in the fall, it may be a little bit later, but this is to talk about cooperative bucks and security, in the high level defense industry, and I hope we'll have Les come back and speak to us too, because he will have a wealth of information. He's not coming into it, obviously, from a pacifist perspective, but from a business and defense perspective.

**I seek clearly a mood for cooperation, that's developed as a result of these financial ventures that are starting to take place.**

The real exciting part, although we hear a lot about the scientific ventures here in business too is, in fact, the financial aspect of the cooperative ventures. I seek clearly a mood for cooperation, that's developed as a result of these financial ventures that are starting to take place. There's a new world economic order, obviously, forming. What is our place? What is our space role in that new economic order that Hazel Henderson and other global economists talk about?

We have people studying to facilitate the financial aspects of cooperation for us. There's a group from the west studying how the ruble can be converted into current currency, so, though that's been a major stumbling block, to joint ventures, it's soon to disappear.

Now, a little bit more data dumps. The San Francisco/Moscow computer teleport has many companies that are on-line, and this is only a partial list: AT&T, Disney, Omni, and Scientific American magazine, Ben & Jerry's Ice Cream, I mentioned Planetary Society — all kinds of universities. Harvard is working now with satellites with 10,000 doctors on eliminating Third World medical diseases and problems. Columbia University is not only listening to the news live from the Molnia orbit, but they're working on professional information, exchanges on molecular genetics, lots more of those. Financial and Wall Street houses are all over the boards, link-on computer to Moscow. Another one, U.S.S.R. Trade Council, has been formed, of jointly owned businesses doing business.

There's a military bulletin, this is not publicly known yet, their sixth issue has actually been developed. It's in negotiations right now, going on-line, where you and I could dialogue with experts who have written articles, military industry in the Soviet Union, no censorship, on everything from chemical weapons to INF, the Foundation for Survival and Development of Humanities, studying the hypotheses to survival, including people like MacNamara, Weisner, Susan Eisenhower, Jeremy Stone; the Soviet Union, their counterparts, including Velikov, Hans Peter Durk, Sakarov — some names that you wouldn't expect to see going out in public having dialogue.

The Moscow Aviation Institute, where Soviet training of rocket and space experts are developing and want to develop permanent relations with students and faculties are live on-line, and New York State University Board of Education is going live on-line with Moscow to put conferencing into the schools. Some of you may say this is just propaganda, it's irrelevant. Well, I don't think it is, and if you do think it is, what I want to ask you is have you lost your nerve and your sense of love and human openness? Are you willing to at least dialogue? Get online! Let's start talking with the Soviets and work in that frame of reference.

The last part of this speech is about what's going on in the "conversion" area.

MAD is going on just like we thought, but it's transforming into Mutual Assured Development. I'm speaking to one MAD conference, The Alliance for Survival, about 25 groups are putting on at the end of April in California. Development is what we're all talking about at state and local areas. Industries don't need to close down, and the defense budget can continue, when the assurance is over, thanks to space.

I'm sorry I don't have time to give you state and locale levels of the exciting meetings and legislation. Groups that have formed, like High Tech Professionals for Peace, "Peace Works," "Jobs for Peace," and so on, and labor unions are joining into this who are providing various forms of support for people, who are trapped in jobs and who don't want to work on weapons widgets. How to convert! There are experts ready to go out and work with industries on conversion and job finding. Grants and money are even becoming available. The Center for Economic Conversion in California, Michael Klossen is a great contact about who is doing that.

Why is there not much press or knowledge about some of this? Because it's just beginning. The people want links with the USSR and people around the world. People want security, and we all want to prosper. We all want to solve the problems of the planet. Confrontation is becoming obsolete.

The media is starting to pick up on it now. Ted Turner, the "mouth from the south," has now provided us with the "Portrait of the Soviet Union" on his CNN, or TSN network, as well as the Moscow Goodwill Games, which you haven't seen; they're fabulous, especially through the productions of the people, and most important of all is the Global Village News that Ted Turner is forming as a model for "good" news. He's now in touch with nearly a hundred countries and a hundred broadcasters, daily, feeding information for the World News Report. If you don't get cable, you ought to try to tune in when you're in a city where you can see it. It's unbelievably fantastic, unlike any other news, live uncensored from around the world. Helping form the global village and peace is Ted's intention, including productions through the Better World Society.

**Ted Turner... has now provided us with the "Portrait of the Soviet Union"**

We all have an interest in all of this. It's important for the world to work together, not only because of the man-made and natural threats to our planet, also so that we survive without duplicating our international efforts, as well as so that we get out into space in a new way, working together, seeing what each country has to offer, cooperatively, through the UN, complementing our own private interests, and working through laws and treaties that exist. There is a need to be creative, and it's time now for us to look at this in terms of the new President, new treaties and legislation, and what might be coming.

There's a spiritual element to all of this, that I, needless to say, don't have time to go into, but I want to mention that at this very moment, where I'm ending, (perfect timing) is that in Europe, right now in London, in fact, are 100 spiritual leaders, including Mother Theresa and the Dali Lama meeting. There's 80 world parliamentarians and 20 media people like Bill Moyer, "thinking themselves with us," in this room, sending us the following meditation and vision, if you will:

They would like for us to, with them, envision how it will be, what we as individuals and as a collective mind want, what we want the world to look like. Envision it. Use the information that's been presented today, and what you're going to get during the next few days, and put your own thoughts and information to it. Hold those thoughts as you proceed because a lot of the information we get is being presented in the old context, because a lot of people don't know about this new game.

And finally, release the vision, and look into your hearts, and say is there anybody in this room, who really, in your deepest heart and soul, believes that space weapons ought to be put above our heads; that we ought to continue with such a momentum when we have a one time choice of going into another direction, and when you get to that place inside of you, and you think about the hero that you always wanted to be, whether it was up at bat or solving the problems in your family, think to yourself, what's in my heart, what do I believe. Most important of all, am I willing to stand up, finally, and tell the truth, and create the vision that we all know is possible. That means putting a literal lid on the intention of putting weapons into space for any reason and transforming the R&D programs into what we want. The SDI and space weapons are unacceptable now, because we have the choice of putting all that energy into, and you know we've got the power, to create a new extended version of cooperation. Space holds the key, then, to the creation of our vision, if we get away from that distraction and diversion of space-based weaponry and substitute it with other visions.

May there be peace on earth through peace in space. Thank you.

**DR. FORMAN:** I did tell you she was going to be passionate.

Our next panelist is Donald E. Fink. Okay, folks, what's the Bible of the aerospace industry? Altogether now,"Aviation Week and Space Technology," right? Right.

**Space holds the key, then, to the creation of our vision, if we get away from that distraction and diversion of space-based weaponry and substitute it with other visions.**

Where is the best and most expert coverage of the space programs in every nation on earth? "Aviation Week," where you find consummately savvy political coverage of the Washington space policy scene. What's the one-stop-shopping place for any researcher looking to get smart on anything to do with aerospace technology and engineering?

**AUDIENCE:** "Aviation Week."

**DR. FORMAN:** And today, we have with us, Mr. Aviation Week, his very own self, Don Fink, editor -in -chief, live and in person.

Don Fink has, in fact, spent his entire professional career at "AvWeek" starting in 1962, as engineering editor in New York, and learning every aspect of his craft in successive assignments as space technology editor in Washington, assistant European editor in Geneva, Paris Bureau Chief, Los Angeles Bureau Chief, managing technical editor in New York, and finally, as of 1985, the ultimate accolade, editor-in-chief. We're lucky to have him with us today. Don, you're on.

**MR. FINK:** Thank you, Brenda, I'm not running for office.

Good afternoon. It's a pleasure and an honor to be here today, to join this distinguished panel and to take part in the discussion, which I consider to be a very important topic, as far as our nation is concerned.

When I was asked to join this Symposium and share my impressions of the state of the U.S. National Space Program, my immediate response was that I would be happy to do so, because I think this is an issue that needs to be addressed from a wide range of forums. It's an issue of particular interest to all of us here today because of our participation in and preoccupation with the aerospace activities. But the U.S. Space Program issue transcends the boundaries of the technical and engineering communities, and it would be an important factor in how successful our nation is in pursuing its so-called competitive strategies policies in the coming decade.

The Space Program has been a topic of considerable debate in many circles. But over the last couple of years, I have had the uneasy feeling that not many people are listening, at least not those who should be listening and should do something about it.

I have commented negatively on the staid pace and content of the U.S. Space Program, both with the written word and the spoken word, and with more than a little justification.

*DONALD E. FINK, JR. is the Editor-in-Chief of "Aviation Week and Space Technology" magazine. His career with "Aviation Week" began in 1962. Since then, he has held a variety of positions in the U.S. and Europe, from New York and Los Angeles, to Geneva and Paris. He assumed his present position in 1985. Prior to joining "Aviation Week," he spent a year at the Cedar Rapids (Iowa) Gazette as a police reporter and aviation writer. Mr. Fink received a B.S. in Technical Journalism from the University of Minnesota. He is a commercial pilot with multi-engine, instrument and rotary wing ratings.*

There are many areas of activity or, perhaps better put, inactivity, that this nation needs to address with vigor, and an overriding sense of urgency, if we're going to get the space plan back on track. I think it's appropriate at the outset to rhetorically ask whether this really is such a burning issue, when one looks at the many serious problems that our nation faces. Who cares what happens or does not happen to the U.S. Space Program?

In my opinion, all of us should care, not just all of us in this room, but all of us in this United States. Now, we shouldn't care from a strictly parochial point of view, we shouldn't care because we want to build trees for America, because we want to build the strongest, the best Space Program in the world, and show the rest of the world what we can do and do it without them. I wholeheartedly subscribe to the idea that we should do this in a cooperative way, primarily, because there are a lot of resources that we can call on out there, and also because the task is too big for any one nation to undertake by itself.

In my opinion, all of us should care about what happens to the U.S. Space Program, for some specific reasons.

First off, space is the new frontier. Gen. Phillips, I think, very eloquently scoped that out, in his remarks earlier.Never before in history has mankind faced such a vast frontier, one that for all intents and purposes is limitless, one that is filled with unparalleled potential,

**I wholeheartedly subscribe to the idea that we should do this in a cooperative way,... because the task is too big for any one nation to undertake by itself.**

and one that poses such a formidable challenge to men's and women's ingenuity.

Second, pursuing a policy of leadership in space brings with it many other advantages, international prestige, diplomatic and political leadership, enhanced competitive stance, and most certainly technical progress, among others.

**I think it's appropriate at the outset to rhetorically ask whether this really is such a burning issue, when one looks at the many serious problems that our nation faces.**

Third, research and development for space projects have spawned tremendous technological advances, and advanced technology is the key to this nation remaining competitive in the future.

Fourth, the United States does not have a monopoly on the space research and development capability, either in the manned or unmanned categories. If we, as a nation, do not stay committed to a strong Space Program, it doesn't mean that other nations will not forge ahead.

We see what's happening with the vigorous Soviet Space Program. We see what the Europeans are doing individually and collectively. Japan, China, even India and Brazil, all are pursuing Space Programs on varying degrees but are all pursuing these Space Programs as part of their national policy.

**Pursuing a policy of leadership in space brings with it many other advantages, international prestige, diplomatic and political leadership, enhanced competitive stance, and most certainly technical progress, among others.**

Fifth—and even though people don't like to talk about it, space has obvious military significance. There's no way we can get around that. It is the new high ground, and the U.S. military establishment has to occupy that high ground, occupy it in a responsible way, but nevertheless occupy that high ground, for obvious strategic reasons.

Communications, surveillance, weather forecasting, reconnaissance and, yes, strategic defense, SDI, and other applications, all dictate that we bear in mind that the military has a role to play in space.

Sixth, is the fact that the U.S. pursued a vigorous broadly based Space Program in the late 1960s, and late 1970s. It also is a fact that that program was a significant contributor to enhancing the nation's pre-eminent position in the world.

Seventh, investments in space research have brought widespread benefits to mankind, both directly and indirectly in the form of technology transfer.

Eighth, space is big business. It's the new business sector, from a modest one billion dollars in sales in 1960, civilian space activities in the U.S. alone, have grown into a business sector that will see over $25 billion in sales in 1988, and by 1999, it's projected to grow to $31 billion.

Ninth, and finally, space is a new and growing business sector. It only started a little over 30 years ago, with the Soviet launch of Sputnik, but when measured against that humble start, one looks at where we are now and cannot help but marvel.

It's important to state at this point, that the U.S. does have a national space capability, albeit not the healthy and vigorous one that it should have.

The Challenger accident two years ago did not alter that basic fact. The problems encountered with the Titan and Delta expendable launchers did not alter that basic fact, nor have the delays, funding problems and reorientation encountered with the NASA International Space Program, altered that basic fact.

When viewed in balance, however, there are a couple of important qualifications that have to be added.

As a cohesive blueprint or plan for the future, the U.S. National Space Program wasn't until recently more than a little frayed around the edges. It was diffuse, and poorly perceived by industry, Congress, and the taxpaying public alike, and it still leaves much to be desired, in the way of strong central direction.

It must be understood that this is not overlooking the fact that large numbers of dedicated people are diligently pursuing a lot of interesting worthwhile space projects in the U.S., both on a national and an international scale. That is as it should be for the country that has the richest technological resources in the world. But a collection of even the most ambitious space projects still is just that, a collection of space projects.

The Reagan Administration's recently announced National Space Policy was a significant step toward correcting that problem, but as we said in an editorial commenting on that policy, it is too late with too little. The policy did clarify several issues. It certainly set the framework for the overall program, and endorsed the space station and the long-term goals established by the two study commissions, the Paine Commission, and the Sally Ride report. These two established permanent lunar bases, and then target Mars for unmanned sample return missions, and ultimately, the manned landing mission similar to our Apollo lunar program.

It also boosted NASA's fiscal 1989 budget requests by 2.5 billion to $11.5 billion, still wholly inadequate when you look at the tasks ahead, and the resources that can be put to it. It also dedicated $100 million to fund Pathfinder technologies that are critical to those long-range plans.

I think if we keep that ball rolling, we are making progress in the right direction. It also establishes the policy under which private companies can get into the business of satellite launching, and on-orbit operations; however, unfortunately, these moves are already being challenged by Congress.

This nation sorely needed a strong statement of purpose, direction, and priority, to galvanize the unflagging interest in space that persists among the citizens of the United States, and this interest persists despite the fact that our program has been marked with starts and stops, ups and downs, and yes, trials and tragedies. Where better to seek this statement than in the White House, where one of the greatest communicators ever to serve as President of the United States in recent times occupies the Oval Office. Who was better placed and equipped to inspire the citizens of this great nation to point to the stars and say that, my fellow citizens, that is where we are going, and here is why.

It's unfortunate that the President let that process get derailed when he bowed to the cabinet level, squabbling over who controls which sector of the Space Program, and ended up leaving the space policy statement out of his State of the Union speech.

"Aviation Week" broke the National Space Policy story a couple of weeks before the State of the Union speech, and then we watched in consternation as the President made no reference to it in his speech, and later didn't even bother to attend the White House ceremony when it was released to the public.

For those of us who believe that it is important to pursue a strong, active and adequately funded Space Program, for the main goals as well as for the stimulus such an effort gives to the national, technological base, this was a serious oversight - should I say slight? What better way would there have been to focus the attention on the Space Program than to call on the citizens of the United States to support an array of new initiatives in a reorganized and revitalized National Space Program.

The National Space Policy, granted, does cover this, but it does it in dull, dry bureaucratic fashion that inspires no one.

Special care must be taken, however, to ensure that we know what we're doing, that each project is adequately defined, focused, supported, and even more importantly, funded.

**One of the basic problems with our national space effort is that we don't have the projects well defined.**

One of the basic problems with our national space effort is that we don't have the projects well defined. As a nation, we don't know where we're going, or why we're going there, and unfortunately, that applies to a lot of activities other than our Space Program.

Let me take a brief retrospective here and trace some of the ground that Gen. Phillips covered in his presentation. The U.S. already has a colorful and fascinating space history. Only recently, we celebrated the 25th anniversary of John Glenn's ride in space on Mercury/Atlas. One looks at that, and marvels at where we have come, from where we started such a short time ago.

We had very successful Mercury and Gemini programs which were designed and accomplished as preludes to the main event — the Apollo moon landings. Again, after the tragic launch-pad fire, we carried that off without a major hitch; Apollo 13 was no picnic, but we brought everyone back safely. It was time to be proud to be an American and to be a supporter of the U.S. Space Program.

At the same time, we were pursuing aggressive, interplanetary and scientific space programs, aimed at mining the treasure trove of information from near-earth orbit and deep space.

We lofted the networks of weather communications, earth resources, reconnaissance satellites, and I don't think it's an exaggeration to say at that time, the world stood in awe.

By the time we completed the lunar landing exploration missions, it all seemed to start to come unraveled. We didn't salvage Skylab out of the Apollo effort, and that project should have rung everyone's bell. It should have been a clear signal to everyone the value of building each succeeding program directly on the shoulders of its predecessor. Unfortunately, it seems only the Soviet Union learned that lesson, because that is precisely what they have done, and precisely why they have their MIR space station orbiting the earth at this moment (which as you all know has far less capability than our Skylab had in terms of size, and any other measure you want to put on it), while we still debate among ourselves what we might be able to do beginning in 1994, or '95, or whenever.

But how could this all come about in such a short period of time? How could the pre-eminent space-faring nation in the world have slipped so resoundingly from its position of pre-eminence to what, at best, can be described as parity with all the other nations in space?

I might add at this stage, that it's important to keep pre-eminence in its proper perspective. We don't have to

> **We don't have to be pre-eminent everywhere and in everything, but we have to have a solid core of very important programs in which we do exercise pre-eminence, and from that, then, extend the hand of cooperation to our fellow citizens around the world.**

be pre-eminent everywhere and in everything, but we have to have a solid core of very important programs in which we do exercise pre-eminence, and from that, then, extend the hand of cooperation to our fellow citizens around the world.

A big part of the answer is that up to this point, we've had this total lack of an overall space plan. There's been no blueprint, no foreman to see through the facade and bravado to say, "Wait a minute, here's the problem. We don't have a clear idea of what we're doing." And in the process, we threw away the Apollo team experience and hardware.

We threw away the Saturn launch vehicle technology.

We threw away what we had started so well with the Skylab program.

We threw away our planetary and space science technology and experience of leadership, in our haste to move on to the challenge of funding the new re-usable space shuttle system.

We threw away our expendable launch vehicle expertise and future for the same reason.

What do we do now? Do we learn from history, so we do not repeat its mistakes? I would like to think so, but I'm not that optimistic. I may not be seeing it clearly.

Unfortunately, I see too much confusion, misplaced emphasis, turf battles, lack of initiative and indifference to make me optimistic that the U.S. has an aggressive space program as one of its primary national priorities.

I think it is necessary to go back to the basics, to reach out to Mr. and Mrs. John Q. Public, and even more importantly their children, and whip up interest and support.

The future of our Space Program is in our colleges, high schools, and yes, even in our grade schools, and we ought to be doing more to inform, educate and stimulate those students who are our future.

The future of the U.S. Space Program is out there, in the minds and the imaginations of our fellow citizens, young and old, but as with all humans, they're easily distracted. If something or someone goes away long enough, they will forget.

We were a nation in shock for more than half of 1986, following the Challenger accident. That shock has passed, and most of the wounds have healed, but unfortunately, when the space shuttle program ground to a halt, when several of our aging expendable boosters failed, and that activity also stopped, the public was allowed to forget about space, and when the public forgets, officialdom is not far behind. In fact, maybe ahead.

> **The public was allowed to forget about space, and when the public forgets, officialdom is not far behind. In fact, maybe ahead.**

Many will argue, and with a certain amount of logic, that we do not have a truly representative form of government, one that not only listens to the desires of the people but reacts to them. That may be the case, but I remind you, that in the early 1970s, it was a determined group of vocal Star Trek space trekkies who forced NASA to change its plans and rename the first orbiter, "The Enterprise." They felt strongly about it, had a vested interest in the U.S. Space Program, and made themselves heard. We need that kind of participation today, which brings me back to my principal point of the beginning of this discourse. Just because we can't fly at the moment in space, doesn't mean we can't talk about it, and we can't dream of the possibilities and fire the imaginations of our citizens with some bold challenges for the future.

The U.S. Space Program, international as well as domestic, has a loyal public constituency that is interested, enthusiastic and supportive. They have demonstrated this in the past and, make no mistake, that constituency is the real basis of your political support; however, if you in the space community do not nurture them, inform them, excite them, and inspire them, you will lose them, and that, ladies and gentlemen, will be a national disaster.

> **The U.S. Space Program, international as well as domestic, has a loyal public constituency that is interested, enthusiastic and supportive.**

It still can be done. It still can be done from the Oval Office. The curtain is being drawn on eight years of the Reagan Administration, but it still isn't too late for the President to have a shot at rallying the people with a stirring call for a strong Space Program, now that his Administration has defined some affordable and attainable goals.

And that, after all, should be in his self interest as well as the nation's interest.

As we said in the recent "AvWeek" issue calling for the administration to seize the Mars Initiative, the President should not overlook the fact that John Fitzgerald Kennedy still is, and long will be remembered as the visionary President who inspired the U.S. to shoot for the moon.

This nation badly needs another shot of adrenalin like that.

Thank you.

**DR. FORMAN:** Thank you. That was a stirring and thoughtful discussion. I hope we take it to heart because it's all very well to depend on top-down leadership, but top-down leadership means the political ammunition that comes out of bottom-up leadership, and that ultimately comes home to roost with all of us.

Our next panelist is Dr. Joseph P. Allen. It always fascinates me to see how impressively accomplished and versatile America's astronauts are. Once you realize the formidable range of intelligence, education, experience and creativity that lies behind that single word, "astronaut", you wonder why you need to make any other introduction at all, but I'm going to introduce him anyway.

Dr. Joseph P. Allen was a NASA astronaut from 1967 to 1985. He flew on Apollo 15 as mission scientist and he was a mission specialist on two shuttle flights, the most recent of which was that successful and magnificent salvage mission in November of 1984.

During the period between 1975 and 1978, Joe Allen also served as NASA Assistant Administrator for Legislative Affairs.

In 1985, he joined Space Industries, Inc., of Houston as Executive Vice-President, with one of the most comprehensive and demanding charters I've seen on any organization chart. He is responsible for marketing and public relations, user development, and relations with the Congress and NASA. This is one busy man.

This is also one highly effective man, as those of you already know who have been following recent developments in Washington in connection with Space Industries' Industrial Space Facility.

Joe Allen is eminently qualified to talk about the problems and the prospects of the businessman trying to develop the commercial potential of the Space Frontier. And with that, I will let him tell his own story.

Here is Joe Allen.

**DR. ALLEN:** Brenda, thank you very much. I appreciate the introduction greatly. I've looked forward to being with you for some time, although because of the responsibilities that Brenda indicated I had and have, I wasn't sure I was going to be here. It turns out I do have an assignment to communicate our program to NASA, and NASA is about 20,000 people, which keeps a single person very busy, but not nearly as busy as Congress. Congress has 535 members. However it also has close to 20,000 staff people on Capitol Hill now. So my assignment really, over the past two years, has been one of trying to build a consensus. There are a lot of people to talk to in evolving a consensus. We've heard already today how difficult that can be, from Gen. Phillips, from Mr. Fink, and I suspect Jim Beggs, in following me, will add a few of his thoughts about building a consensus.

*DR. JOSEPH ALLEN is Executive Vice President of Space Industries, Inc., a Houston based firm. He joined Space Industries in July 1985. Prior to that, he served as Mission specialist aboard several Shuttle flights. Mr. Allen was part of the first operational Shuttle mission and he also took part in the first salvage mission in space histroy. He has logged a total of 314 hours in space. Mr. Allen received a BA in math-physics from DEPauw in 1959 he then earned an MS and a PhD in phhysics from Yale University in 1961 and 1965. He was a Fullgright Scholar in Germany in 1959 and 1960 and after earning his PhD from Yale was a staff physicist at the Nuclear Structure Laboratory there.*

Indeed, this was brought home when I was asked by your program organizers to talk about the trials, frustrations, obstacles and prospects for building a commercial space business. I had been an astronaut for a number of years, and have had assignments before that, yet I was never asked to give a paper on the "frustrations" of being an astronaut. As I thought about it, I never had to speak on the "frustrations" of being a college student or a college professor either. Goodness knows, there are many frustrations in all these professions.

I would rather think of this business of trying to build a space business as being like that of an astronaut or, for that matter, a college student. There are, to be sure, the chances for failure; one hopes that there are chances for rewards as well; but in balance, I think no one will argue that it's not worth a try, and we at Space Industries right now are operating on exactly that philosophy. We are giving it a very good try. We believe in what we're doing, and we are proud of our success to date. Whether we're effective in the final analysis, I think, in many ways, is of less concern than whether we continue to try to succeed as entrepreneurs on this new and vast frontier of space.

I would like to turn the direction of the discussion right now, and hold my own experience at Space Industries up as a bit of an example — a pithball in the electrical field of politics, if you will — an example of the more general things that the speakers who have preceded me on the panel today talked about.

**I would rather think of this business of trying to build a space business as being like that of an astronaut...but in balance, I think no one will argue that it's not worth a try**

On the space missions that I have participated in, I was the ship's photographer, so I do have in my collection about 6,000 space photos. I have not brought all 6,000 today, just eight, which I thought you would enjoy seeing.

This may not be an object very familiar to very many of you; although as a substance, it certainly is familiar. The photo is taken inside a space shuttle. The object is a sphere; and the substance is Coca Cola — either that or Pepsi Cola — I could never keep them straight. However, this is a carbonated beverage in the miraculous environment of micro-gravity or zero gravity.

I will point out that the gas is mixed with the fluid, and the bubbles, unlike any Coca Cola or Pepsi Cola you've ever seen, suddenly do not know which way is "up." The bubbles wander around in the fluid itself. This has no economic value at all that I know of, but there is considerable discussion about what other gases mixed with other fluids, and turning into solids, may or may not be worth, and what sorts of future economic value they may have.

We've heard some elegant descriptions already of the Space Station. I will call the subject of this photo a "practice space station," because we had it and practiced in it, and unfortunately, let it out of our attention span for so long that we lost it. Skylab was a very capable habitat in space, and was occupied for a number of months by American astronauts in 1973.

This is another space station. We've heard comments about it already today, and I suspect there will be a lot more discussion about it before this week is over. It's the space ship MIR. The current habitat is actually much larger than this initial version because the Russians, as Mr. Fink pointed out to us, are building directly on their immediate successes. They continue to build, and build, and build, one step at a time, onto this basic station.

This is a photo of the mighty Challenger. The photo was taken on STS #7; very easy to remember because you see the arm lifted in salute. It shows the volume in which we can carry out research in space, in a shirt-sleeved atmosphere in the mid-deck and the flight deck of the orbiters — or will carry out research once they start to fly again. In addition, you all know we have in inventory what we call the space lab, an additional work volume that can fit back in the payload bay. Crew members float into it through a tunnel, back in the direction of the two satellite shields at the back of the payload bay.

In addition there is no technical reason that a space lab could not be flown together with a new design called a SPACEHAB, which is an extra building to be attached beyond the space lab. The combination of orbiter, spacelab and SPACEHAB could fly in space, with people working inside that much larger volume for eight to ten days.

We are working on a project called an Industrial Space Facility. It is being undertaken by Space Industries Partnership, the managing partner of which is Space Industries, a company that was founded in 1982 by, among others, Dr. Max Faget who was one of the senior designers of all the American space ships to-date, including the space shuttle.

Prior to the loss of Challenger, Space Industries had designed a facility like this to be a manufacturing facility. It was intended to follow on the heels of a steady state of research and development being done in the space shuttles, in the space labs and on other American-built machines that would be flying at an increasing rate into space through the 1980's.

These hopes, of course, were dashed along with many, many others in January of 1986. Following the Challenger tragedy, we decided, rather than shut the project down, to refocus the use of the Facility to be less manufacturing and more research and development. It was our feeling that with the thrust of the American Space Program languishing, and with the length of time it was taking to get things accomplished in this day and age, the nation could well use an interim step leading into the space station era. This project might be very useful as a part of the U.S.'s space infrastructure, and so we proceeded.

I think that most of you know the technical idea behind the project. It's just a satellite, a pressurized platform. There can be equipment inside working automatically, if we are at the level of technology to have automated equipment and/or robots inside. But there are not people inside. This is not a space station; one might call it an "almost" space station. Nevertheless, it can do only one of the eight or ten things that the American space station will be able to do when it is completed. That one thing is to give us a capability for microgravity research beyond the space shuttle — a hands-on shirt-sleeve capability, and an on-orbit capability until the space station is ready.

**The Industrial Space Facility can... be a bridge into what the future, I hope, will hold.**

Its design is simple. If we start to build it this summer, we could have it ready for launch in 1991, certainly in time for the 500th anniversary of Columbus, which will occur in 1992.

One goes up to the Industrial Space Facility with the space shuttle. One then attaches to the facility and floats through a docking system in shirt sleeves into it. It in many ways is like a space lab in that people are working in it, but they're living in the crew quarters of the space shuttle.

In your mind's eye, you could also picture a space lab in this same space shuttle, and for that matter, one or two SPACEHABS back in the far end of the space shuttle.

This combination of Industrial Space Facility, Space Shuttle, space lab and SPACEHAB is intriguing because power could be drawn from the solar panels of the Facility in addition to the cyrogenics providing power to the space shuttle itself. Thus, the Facility is an orbiter extender. We think it could be very useful in that regard.

The Industrial Space Facility can accommodate space station-like racks. It thus can be a bridge into what the future, I hope, will hold. It also can accommodate what astronauts called mid-deck lockers, in which experimental equipment can be placed and used. These are lockers that we use right now in the current space shuttles, which can also be put into SPACE HABS and into space labs, in addition to the normal space-lab type apparatus.

So the Industrial Space Facility, once again, is a combination of the present and the future.

This slide is an artist's concept of perhaps the year 2000 with one small facility, now converted to manufacturing as we have envisioned all along, which uses the research and development coming off the international space station, shown also in the slide.

**I sometimes think that to the degree that we focus our attention totally on the space station, and forget about a possible interim step, we may be making the same sort of mistake, with regard to orbital capabilities that we made with regard to transportation capabilities in the 1970s.**

I look at this picture and am reminded very much of the earlier discussion about the very bad mistake that many of us in the space community in the 1970s made, and I was, in a sense, certainly part of that. We decided that the space shuttle would be the "be all and end all" of transportation to space. We decided not to keep the expendable launch vehicles in the inventory, but to rely completely on the space shuttle.

I sometimes think that to the degree that we focus our attention totally on the space station, and forget about a possible interim step, we may be making the same sort of mistake, with regard to orbital capabilities that we made with regard to transportation capabilities in the 1970s.

I hope that is not the case. There's a certain American tradition in that we are entrepreneurs and utilizers of new frontiers; that in many ways is the very essence of our national history. I hope to goodness that this tradition is not about to change. I know that a lot of people are working very hard to make certain it doesn't change. Indeed the thrust of this conference, in many ways, is to generate an enthusiasm and an understanding of the opportunities in space so that it does not change.

I hope that we Americans are among the countries of the world that will continue to invest in space projects.

I was shaken a little bit when I picked up the local Denver paper this morning and saw that my very favorite ski resort, Breckenridge had been sold. It was not bought by Americans. I'm sure it will continue to be a good ski resort, yet I don't want to see all of Colorado sold to entrepreneurs from other countries and I most certainly don't want to see all of space, the next frontier, occupied exclusively by entrepreneurs from other countries.

The last thought I would like to leave you with is this idea of time. You know, when Gen. Phillips and others started the Space Program, the length of time between concept, design and construction was the order of one or two years. NASA was started in 1958, and the first Mercury spaceships were starting to be delivered as test articles in 1959.

By contrast, there was a strong recommendation in 1975 to the then NASA administrator about the next obvious step beyond the space shuttle. That recommendation was for a permanent outpost in space, a habitat, a space station.

The recommendation was not acted upon until Mr. Beggs carried that message to the White House, and the President announced in 1984 that one of the goals of the nation would be a permanent space station.

We're in 1988 right now. Thirteen years have elapsed since the initial concept. It worries me to hear the projections of the space station being available now fall in 1996, '97, '98 — nearly 20 years since the initial recommendation to build a station.

**I most certainly don't want to see all of space, the next frontier, occupied exclusively by entrepreneurs from other countries**

I can think of nothing more fun than to go to that space station as an astronaut, and I'm starting to get too old to make that journey.

Our own small space project is now six years old. It too has taken far too long to implement.

It was started by a few investors in the state of Texas at the same time that another small company, called Compaq Computer, was started.

Space Industries, of late, has gotten some attention in the newspaper but the project is not yet underway.

Compaq Computer has by contrast achieved one billion dollars in sales for one year's time.

That is one of the problems of being in the space business right now. It takes so long to form a consensus, and to get projects underway. I think you will hear that theme again and again over the course of this week. But it is vital to keep trying.

Thank you very much.

**DR. FORMAN:** Thank you, Joe. Joe has a really killing schedule and he managed to make this panel in between coming from Houston to Washington. He's out again tonight, so they select astronauts for endurance as well as everything else.

The last panelist this afternoon is James M. Beggs, a name I don't really have to explain to any of you, do I? From 1981 to 1985, Jim Beggs was one of the strongest and most effective administrators that NASA has ever had. The President listened to him, the Congress respected him. A strong leader with a clear sense of direction, he was knowledgeable in the ways of both business and government; he gave the space agency the sort of leadership it has to have if our Space Program is ever to recover, and we hope, flourish.

We need as many more like him as we can get, and I don't know if we will ever be able to get him again, but maybe we can clone him.

But that's only one aspect of a long and distinguished career in both government and business. Beginning at the Westinghouse Electric Corporation, where he rose to Vice-President of the Defense and Space Center, Jim Beggs went on to spend a year at NASA in the late 1960s as Associate Administrator for the Office of Advanced Research and Technology.

Then he spent four years as Under Secretary of the Department of Transportation under the Nixon/Ford administration. Leaving government in 1973, he became Managing Director for Operations of the Summa Corporation, and then he moved over to General Dynamics Corporation as Executive Vice-President where he spent the next seven years.

In 1981, he became NASA Administrator, and since his departure from NASA in 1985, he seems to have found that one job wasn't enough to occupy his formidable energies. So now he has two. He is the President and Chief Operating Officer of the newly formed Defense Group, Incorporated, which is a high technology, defense-focused business to provide products and services to diverse public and private sector clients in the areas of signature management and maritime technologies. And in his spare time, he's also the Chairman of Spacehab, Inc., that high powered young firm that's designing and building a module for the shuttle's middeck to expand the shuttle's available shirtsleeve environment area. I give you Jim Beggs.

**MR. BEGGS:** Thank you very much. I'm delighted to be here, and thank you, Brenda, for that generous introduction. If you all can figure out what we're doing in DGI, come tell me after this is over.

*JAMES BEGGS is currently the President and Chief Operating Officer of the newly formed Defense Group Incorporated. Prior to joining Defense Group Incorporated, he served as the NASA Administrator. Mr. Beggs has served as: the Executive Vice President for General Dynamics Corporation from 1974 - 1981; Managing Director of Operations for Summa Corporation from 1973 -1974; Under Secretary of the Department of Transportation for the U.S. Government from 1969-1973; and Associate Administrator for the Office of Advanced Research and Technology for NASA from 1968-1969. Mr. Beggs served in the United States Navy from 1947-1954 as a line officer from Ensign to Lieutenant Commander. Mr. Beggs received a B.S. in Engineering from the United States Naval Academy, and an MBA from Harvard Graduate School of Business Administration. His Honorary degrees include; a LLD degree from Washington and Jefferson College, a Doctor of Engineering Management from Embry-Riddle Aeronautical University, a LLD from Maryville College, a Doctor of Science from the University of Alabama, and a Doctor of Aeronautical Science from Salem College.*

I'm out here because I enjoy these conferences. I think that Gen. Jim Hill and Dick MacLeod are doing a marvelous job of bringing us all together each year to exchange views and review the progress we've made, and maybe discuss some of the mistakes we've made, so that we can get on with the tasks in a better fashion in the coming year. I'm pleased to see the good attendance out here, and delighted to be here.

I'm privileged to come on last because I wanted to hear Joe Allen, and when Joe got up here and talked about viewgraphs, it reminded me of that old NASA story which many of you have heard. I will tell it anyway.

There was this old man who had retired from NASA, and his grandson came to him one day, and said "Granddaddy," he said, "you were in the Space Program in the Houston days. Tell me about it."

And the old man leaned back, and he said, "I would be delighted young man. May I have the first viewgraph, please."

We can't talk without them, but I'm going to try this afternoon.

You have heard where we've been, and where we've been for the last 30 years is truly remarkable. I think sometimes we forget how far we have come in 30 years. You have heard how hard it is to do the kinds of things that we seemed to do with ease in the early years, and presently that's true too. We have somehow made it much more difficult for ourselves, as time goes on, and it may just be that we have forgotten the fundamentals. There's an old saying in the sports world, "get back to the fundamentals," and I think, perhaps, that is exactly what we need to do in our Space Program, both civil and military: get back to the fundamentals. Because when we do it right, we do it very, very well. We are the envy of the world when we put our minds to doing something really marvelous, and then to set about doing it in the right way, for we know how to do it in the right way.

The President, I think, has left us with a great legacy: the National Space Policy is a splendid favor. I think it sets our sights high, and I hope that as we come through the quadrennial madness that we end up with a Chief Executive of this country who will set about putting in place the proper team, providing the proper budget, and allowing us to get on with the job.

The primary element in the space policy is leadership. We said that initially back in 1958, and indeed, NASA and the nation are under a statutory injunction to be a leader in space, at least on the civil side. And that means that we will remain pre-eminent. As Don Fink said, I'm at least a critical technologist, if you're going to remain pre-eminent in the critical technologies, it means for a fact, you have to spend the money to do that job, and stay ahead.

That means there must be a strong civil government, publicly funded Space Program. Without that, there will be nothing else, and that includes commercialization. It means our international cooperative endeavors. It means everything that we have grown to believe in, as being important in our development of high technology, of which space is but the leading element.

Commercialization is important. When I was in NASA, I thought we ought to turn over the initiative to commercial entities to develop those things which look like they have at least a chance of becoming profitable, of earning a satisfactory return. And so it was that it started with a letter from David Hannah, who was thinking about launching a private space booster. He wrote and asked, "Where do I go to get a permit to launch a booster privately in space?"

That got us to thinking. Neil Hosenball is here, and since I'm not going to be staying tomorrow, you will have the opportunity to grill Neil on this. I urge you to do so because he was a partner in the crime. We decided that NASA did not want to be a regulatory agency; therefore, we had to find someone who would take over this job of issuing permits and clearing the way for private enterprise to do their thing in space. And so we wrote a paper, which is what you do in government, and sent it over to the White House for the Security Council to say something should be done. That set off the train of events that resulted in what Don Fink and others have referred to as a turf fight, and there's nothing worse in Washington. All of which makes the old adage true, "no good deed goes unpunished."

**There must be a strong civil government, publicly funded Space Program. Without that, there will be nothing else, and that includes commercialization.**

We're going to be searching out the roles of the various departments in this endeavor, and I'm not entirely pessimistic. I'm a little bit worried about what's going on right now, but I'm not pessimistic; they will be sorted out in due time. I think it's important to keep in mind that the present space policy and the statutory bills and regulations that we have put NASA in the leading position, and I think NASA must exercise that leading position in spite of what is done or in addition to what is done in the various executive departments.

I do not think that NASA has to be in a large department. I would not come out in favor of a Department of Science, or even a departmental rank for the agency. I think what is more important is an ability to have a dialogue with the Chief Executive, and I was privileged to have that with this President. I think we did rather well with this President, in terms of his support.

I subscribe to what Sam Phillips said; I think we must bring back something like the National Aeronautics Space Council, so that we have an existing group in the White House that can work the issues, can make sure that things are coordinated and that nothing goes awry as we are trying to develop our activities in the future to meet the President's injunction and to go forward with that policy. I hope that as time goes on the new administration will find a way to implement that.

**If I can leave you with a singular message, it would be: Science and space have no constituency.**

Indeed, I would hope that the new administration will have a strong voice, both in science in general, and the Space Program in particular.

If I can leave you with a singular message, it would be: Science and space have no constituency. I know we're all together in this room, and I know there are at any given time upwards of 150,000 people who work on the Space Program, one way or the other, in both the industry and the universities, and NASA itself. I know there's a larger constituency that follows the program, but in spite of that, there is no political constituency for science, high tech and space in this country. I hope we can think about that and do something about it.

This is about the only group that I know that has almost totally altruistic motives in their approach to things. We don't think in political terms, but if you've walked the halls of the Congress, and I know many of you have, as I have, you will find that when you get into arguments about how large the NASA budget should be, or how much money we should spend, the reaction you get from Congressmen and Senators is, "isn't it too bad that we have no public constituency for this program, because if we did, it would make it ever so much easier to do what you wanted to do." I think we've got to work on that.

Let's see whether we can do as well with the journalists as others do. Let's see whether we can do as well with politicians as others do, and that means, perhaps, eventually putting together all of the talents and the many groups that believe in and work for space in a political way to try to develop that consensus. It ought to be easy to do because any poll that you read concludes that upwards of 80 percent of the American public think that high tech and space, in particular, is very important for the future of the country. All of them support spending at least as much or perhaps more money to pursue the program.

We've got to build that constituency. As we move out into the last decade of this century, and move towards that magic year, a year which has three zeros, pretty soon the newspaper and magazines are going to start to write articles about the third millenium, and what we are going to do in the third millenium.

Well, we've got just a little over one decade to get ready for it. In 1992, we're going to have another International Space Year, and we are going to be, I hope, on the road to getting our space station in place. We should be, if the Congress will allow it, over the hump of the peak of funding for the space station program so we will be ready to take on another challenge.

I would suggest that we consider that marvelous program which would be truly an international event, the Mission to Planet Earth. Mission to Planet Earth would cost us about a billion dollars per year, and it would cost the Soviets, if they were to enter into it, about the same amount of money. We would establish for the first time a long-term observation of our small planet and find out what really is happening to this planet.

We might even find that it's not nearly as bad as the environmentalists say. It can't be that bad—or we might find that it's worse, but certainly, we ought to know. Mission to Planet Earth would get us on the road to establish a baseline over a ten-year program. We need more data to find out what Planet Earth is really like, and what we're doing to it, and whether we are, indeed, depleting its resources.

I think we will have splendid international cooperation because the Soviets are willing to come, as are the Europeans, and the Japanese and so are a number of other countries interested in going into space with us.

**Just this morning, the astronomers announced they had observed a galaxy so distant that it reaches back to the beginning of time.**

By the time we get the space station operational in the mid '90s, we will have the platform to do many of the studies, to make many of the observations, and we can proceed from there into the many things that we intend to do to expand our outreach into the universe. By the early '90s, we will have the large space telescope in orbit, which will be one of the most important scientific instruments we've ever launched.

Just this morning, the astronomers announced they had observed a galaxy so distant that it reaches back to the beginning of time. If the red shift readings are correct, it looks like it goes back 12 billion years, and the stars look like they're one billion years old.

If so, we are starting to reach back and get the information that will allow us to understand the beginning and, perhaps, begin to understand how it will end, and what more profound and great adventure can there be than understanding that fundamental mystery.

All we need to continue the dream is to spend a little money.

We finally got the budget up to the one percent of the federal budget that I had hoped we would. If we can have that kind of resource for the next decade or so, as we approach that third millenium, I think we can plan our way into that marvelous future.

We can have a healthy civil program, and that, I believe, will result in a healthy military program as well.

All it takes is a will to do it.

**"Sweet are the uses of adversity, which like the toad, ugly and venomous, wears yet a precious jewel in his head, and, this our life, exempt from public haunt finds tongues in trees, books in running brooks, sermons in stones and good in everything."**

We've come through a bad time. And not just because we had a shuttle accident, because bad as that was, perhaps we took our eye off the ball and lost sight of our objective. We've gone through adversity, both in the civil and the military programs, but we're coming out of it. If I can conclude my remarks with a quote from a favorite author — I know you would be disappointed if I didn't quote Shakespeare — "Sweet are the uses of adversity, which like the toad, ugly and venomous, wears yet a precious jewel in his head, and, this our life, exempt from public haunt finds tongues in trees, books in running brooks, sermons in stones and good in everything." Think about it. Thank you.

**DR. FORMAN:** We have some time for Q & A. Thank you to all the panelists for a wonderful afternoon and a wonderful kick-off to what is going to be one hell of a conference.

This is a question for Gen. Phillips. What should be done to prepare the public and the Congress for the STS incident or accident to prevent an overreaction that could be crippling?

**GEN. PHILLIPS:** Well, I think there are a lot of things that need to be done, some of which have already been done. A number of people who are involved in and responsible for the program have pointed out that there are risks in space flight and in spite of the best efforts of human beings there will continue to be risks, and so that's a part of the game.

I think that to the extent that NASA and others of us who are interested in the Space Program can help through the media and otherwise to try to put into perspective the subject of risks, I think that's what we need to do, and that's about as far as I could comment on the question.

**DR. FORMAN:** Absolutely. Anybody on the panel?

**MR. FINK:** I would like to take an opportunity to add a comment to that answer. I think that NASA could benefit greatly by taking a very hard look at how it handled the Challenger accident, and take to heart some of the lessons that were learned in that process. This is never an easy thing to do, and as with airline operations or whatever, people don't like to talk about accidents. Safety is a difficult concept to put across to people when you're trying to instill confidence in them, but it has to be talked about frankly and openly, and God forbid that we do ever have a serious accident or incident with the shuttle system again, we must be prepared to face it forthrightly, quickly, openly, and deal with it in a way that informs the public as quickly as possible.

**DR. FORMAN:** This one wasn't directed to anybody specifically, but I'm going to give it to Jim Beggs. It says $10 to $11 billion seems like a respectable budget, how is it apportioned?

**MR. BEGGS:** Well it's apportioned the same way it has always been apportioned, at least as far as I can remember back to the first time I was in NASA, and Sam was with NASA. We tried to maintain what we described in those days, or what Homer Newell used to describe as a balanced program. That means that about a quarter went into space science, and the exploration of the planets that started with the earth- like planets, the terrestrial planets, and then went on to the primordial planets, and then beyond that, to the study of the universe, which we're just getting on with right now, and, of course, along with that, the very important study on the Planet Earth.

Then about 30 percent or maybe a tad more, depending on where you were in this specific program, was devoted to the business of exploring space, manned or womaned. That effort goes on today, and it varies a little bit, but if you look at it overall, it's in that order of magnitude.

Another 10 percent goes into the development of the technology for the future. That program continues both in aeronautics which is the support of our aeronautic program, but also is partly a support of the Space Program, and space technology, preparing those critical technologies that would allow us to do commissions for the future. Add that up, and it's about 70 percent. The other 30 percent goes to the facilities, the maintenance of the launch capabilities, and the tracking and data acquisition system that we have in place, plus the various things that we keep in space as facilities. By that, I mean instruments that we have up there which cost us an ongoing amount of money.

To give you an example of that, Mark and I made a mistake. We have the Pioneer spacecraft still flying out into the outer reaches of the solar system. It's gone by the orbit Pluto, and it is moving out to what is popularly known in the trade as the helio pause, which is the farthest reach of our sun's influence.

We also have both Voyagers, Voyagers 1 and 2, flying out; they've got better instruments, so Mark and I thought, "let's turn off the Pioneer." Well, I thought I was going to get hanged at dawn, and both of us got summarily summoned to the Congress. We were told we simply couldn't do that. Well, that doesn't sound like much, but it costs us $5 to $6 million a year just to keep the Pioneer pumping data into the systems, so that those kinds of things take the risk of money, and believe me, well, you don't have to believe me, go back and review the budget. That's generally been the way it's been allocated for at least the last 25 years. Did I answer the question right?

**DR. FORMAN:** It sounds to me like you did splendidly. I have a question for Joe Allen. What major milestones do you envision to reach the goal of space manufacturing?

**DR. ALLEN:** That requires a crystal ball. I think what we, in this country, need to do as is already being done in other countries, is to get lots of research and development time with materials in microgravity. Two things will then happen. The first is we will have more new questions. The second is we come up with more ideas of possible applications. Until that happens, we cannot speculate very well about the probability of space manufacturing being doable or not doable in the future. Of course, whether it's doable or not has to do with two things. Is there something about the environment that really is unique? I think the answer to that is yes. Perpetual balance of forces is, believe me, unique. I assure you, it looks unique, and I think that the physics of it says it's unique. That's the first question; is there something there that's unique?

The second question: is there something there that has an economic element to it? And the economic element depends really on lots of others things in addition to the physics. What does it cost to get there, for example.

Some years ago, if I had been told that we, in this country, would send manuscripts and paper halfway around the world to have them made into books which were then sent back to us, I would say that made no economic sense at all.

It happens all the time right now. It makes economic sense to do it, because transportation is cheap.

**DR. FORMAN:** Here's a question that says if we're doing so well in starting international cooperation in space, where is China and the Soviet Union, etc.?

China is really just beginning its Space Program and what they're really concentrating on is selling the launch services of the Long March. The Soviet Union has been extremely adept and very skilled in promoting international participation in its own space program. If you have noticed, they've flown an awful lot of cosmonauts from different countries, which is wonderful public relations, quite apart from whatever else it may do.

The Kvant astrophysics module they attached to the Mir space station has a whole group of experiments on it from European countries. The Soviets are inviting much wider participation in the Mir, and they are going to be launching four more specialized modules over the next two or three years which will also contain very extensive experiments and equipment from other countries. So they're doing very, very skilled and very adept work in that area, and we might take a lesson or six from them on that.

**DR. ROSIN:** Tomorrow, I will give to you an Institute for Security and Cooperation in Outer Space (ISCOS) newsletter, in which we have actually outlined some of the major countries' space activities, that I think will answer that question.

I recently returned from China. They are, through their modernization program, calling on experts from all over the country. And while I was there, there were several people there from different countries consulting with information and expertise to help build up their space programs, mainly in the areas, while I was there, of satellite surveillance, reconnaissance for example, to help this vast terrain be protected for the people, and to learn how to improve their management communication systems.

**DR. FORMAN:** Here are two questions that I think I'm going to combine, because I think they are two pieces of the same question. I'll direct them to Jim Beggs and Sam Phillips. First part of it is, thinking of the operational NASA, i.e., the shuttle and space station to come and the R&D/NASA, is some restructuring of the agency needed; and the second question remarks that "Forbes Magazine" recently called for dismantling NASA. Is NASA standing in the way of the commercialization in space? So set your teeth in that one. General Phillips, do you want to go first?

**GEN. PHILLIPS:** Those are meaty questions, and I'm not sure that all of us at this table would agree completely on the right answers, but I guess that's part of what this meeting is all about.

In the work that I have done with Dr. Fletcher, the current NASA Administrator, in offering advice and recommendations concerning how NASA manages its business, I have strongly recommended that the job of operations, the management of space operations, which largely concerns manned and man-related flights, be organized differently than it is currently. In that respect, there would be a sharper organizational delineation between research and development, and the day-to-day, week-to-week, for that matter, year-to-year operations activities.

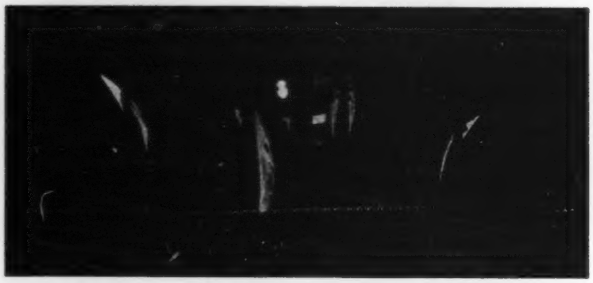
I have recommended that an operations organization be established, which would be responsible for the preparation, planning, execution, and conduct of operations, and for developing features that are unique to the operation requirement, and common, generally, to more than one program; and that the space flight development programs, such as the space station, as a new one, and the many others that are in NASA's future, be separated from the operations job.

I think that a clear delineation between the operations job, and the R&D job including defining and developing new systems, would permit a stronger management focus on the two quite different categories of activities, and would progressively lead to development of professionals in the field of operations, where in many respects, different skills and different kinds of thinking are involved and required, from those that are required for research and development. So those are a few thoughts on the subject of delineation between operations and R&D, within the NASA structure.

I've read the "Forbes" article. I don't agree with it. I think it does a disservice to what is really needed for us as a nation to plan and manage an aggressive and effective National Space Program. Starting with the Space Act of 1958, NASA was created rather quickly, and it has grown and evolved.

There are many things about any organization that evolves over a period of 30 years that can profitably be changed, but to destroy it is not the right way to do it. We would be far better off to identify and fix the shortcomings of the current organization, and find ways to deal with some of the political roadblocks to fixing some of those problems, and there are political roadblocks, than we would be as the "Forbes" article suggests, to destroy NASA and start over. Jim, the mike is yours.

**MR. BEGGS:** I subscribe to what Sam said. I think there should be a point at which one turns over to an operational group, either within NASA or, perhaps, to a contractor operation. Certainly, there is a point where NASA should turn loose of it as an R&D facility or R&D program, and make it fully operational, and turn it over to a group that is operationally inclined. As Sam said, developing that kind of a transition in NASA could result in the development kind of skills that one needs, in order to operate things in a way that makes them truly operational. It's not quite as easy, however, as transitioning from R&D to operations in the military program, but I think it can be done, and as a matter of fact, we were doing that kind of thing, while I was in NASA, trying to figure out at what point we can transition into a fully operational system and turn it over to an operational entity.



I completely subscribe to what Sam said about the "Forbes" article. I think that Forbes does a terrible disservice; as do various articles that appeared in a number of places which purport to say, well, all we had to do was get the government out of this thing, and it will take off like a skyrocket. It will not do that, and the plain facts are that if you look back in history, at the great missions of exploration, the great voyages of exploration, they were all, in one way or another, government subsidized, and government directed. The idea that you can turn loose of this one, just when we are on the verge of reaching out to the edge of the universe is silly, in my view, and distorts the whole program.

There is a place for commercialization, as I said in my remarks, and I think you should open that fully. But to say, let's destroy what we have built up to this point, and go on completely in the hope that somebody will do the things that need to be done is just lunacy.

**DR. FORMAN:** Here's a question for Carol Rosin. What are the implications for DOD clearances in participating in U.S./Soviet conversations?

**DR. ROSIN:** I'm not an expert in this area, but I would imagine that after the President goes to the Soviet Union, it's going to be a lot easier to get clearance to go there. I believe high level officers will soon travel extensively between countries. There's obviously a problem right now, although people with security clearances have gone to the Soviet Union and have participated in different meetings. There is going to have to be a study of how to make extensive changes in that area, because I know from responses I've got from U.S. people who want to go, the main negative is, "I would love to go, I want to meet my counterpart, but I don't have clearance, and I will never get out of here." The visa problems are gradually letting up, with the process now that's obviously geared towards international industry and military, to military conversation taking place, not only on the inactive or retired officer level, but on the active officer and soldier, executive and worker levels. There will be advances made in the clearance area, I believe. It's an aspect of "military transformation, or conversion."

**DR. FORMAN:** Here are two questions that I'm going to consolidate and give to Don Fink. First, is there a clear understanding of the leading presidential candidates' positions on the Space Program, both NASA and DOD, and second, rephrasing that to some degree, what stands have the remaining presidential candidates taken on restoring the American space leadership, and why don't you try to bring candidates out more in this area by covering primary candidates more completely, including the debates?

**MR. FINK:** Well, the answer to the first question is no, and it has been a concern of ours. In fact, we launched our newly reformatted "Aviation Week and Space Technology" with the January 4 issue. It had a cover story on it, which said,"Will Anyone Speak for Aerospace?" We raised this question, and tried to treat it in considerable depth.

The issue is extremely important to the United States, as a nation, not just those of us who are interested in this activity, whether it be through the Space Program or through various aviation programs or the military. It is a question of national importance, and I share the concerns of the questioners that we are not seeing evidence of that yet with any of the political candidates. We chose not to get deeply involved in the primaries, because through their committees, we asked each of the candidates what their stand was on aerospace, in general, and the Space Program in particular, and, in effect, we got negative, if not indifferent responses. So we felt, having commented on that, that we would let things sort themselves out, and go after the survivors. We are going to do that, and you will see that in a couple of months.

**DR. FORMAN:** I would like to add to that. I presented myself as a concerned citizen on the telephone for quite a bit of time a couple of months ago, and asked every single one of what was then the thundering herd of candidates what their position was on space. What I got was a range from mealy- mouthed nothings, to a couple of really well thought-out positions.

Just recently, believe it or not, Michael Dukakis came out with a statement on space which is really quite good. It's not perfect, but it's clear that his campaign has thought the issues through and addressed all the questions, and in a lot of cases, come up with the right answers. Jesse Jackson also has a statement on space which is very different in tone, as you might expect, and I doubt very much that it would be one that we would like to see made our national space policy as it stands now, but it was encouraging that at least he's paying attention to the issue, which is more than some of the other candidates seem to have done.

On the other side of the party divide, Bush has given a speech at Huntsville which said some of the right things, but I don't think I have heard him say anything about it since then. So that's where we are right now. Oh, yes, Gore has given a speech up in Dartmouth which is also an extremely good piece.

Now, whether saying the right things in a campaign speech equates to really believing this when you're actually in office is an open question with any candidate, but that's where anything that might vaguely be called a constituency for space comes in. And that's you and me. Which means we've got to beat up on them when the time comes. But at least the surviving candidates have gotten to the point where they paid attention to the issue to the point of putting together something that resembles a coherent statement on the subject. That was not true two months ago.

Moving right along, why don't we take this question that is directed to all the panelists and just take it one by one. If you each have to pick a future space project that you considered most important, which would that be? Why don't we just start at that end of the table and work our way down. Joe, you're on.

**DR. ALLEN:** Oh, boy. Well, I will start with the most immediate, but I might cheat a little bit and go on to a second. Get the space shuttle flying again, and in a robust healthy way. I know that is in the works and I have every reason to be optimistic it will happen shortly.

The second is to look into the space station era. We must get on with that, it's been suggested for nearly 25 years now, let's get on with it.

**DR. ROSIN:** My project would be a major plan to replace the Strategic Defense Initiative with a program that's greater than the magnitude of the SDI, and space weapons R & D. That is, it would be a project that would be defined as research and development program, perhaps a Strategic Development Initiative, another version of the SDI, where most of the research could continue, but it would be applied to conversion and to building cooperative security systems, including enhancement of surveillance, reconnaissance, sensing radar, navigation, communication, et cetera, using the best of the industry and military skills. It would be to develop an R&D program, including a lot of the projects that have been mentioned: the shuttle, Mars, space station etc., cooperatively or privately for economic development, and that would be to develop a whole new marketplace of products and services that can be applied directly to solving the immediate problems of earth's environment, as far as the ozone, pollution, et cetera, and of hunger, including distributing food, health (epidemics), water, and so on. Global education will spread.

So my SDI would be an extensive project that's greater than the magnitude of the other SDI and would include all of these projects and more because there would be less "secrets," and would include the Soviet work, and that of the Eastern Bloc including all the countries of the world in a grid that would show what each country's doing, so that we don't duplicate efforts, and what each country can contribute, based on its individual needs right down to the state and local levels of all of our manmade boundaries. This makes common sense to me.

**DR. FORMAN:** Thank you. I'm going to pass it on to Sam Phillips.

**GEN. PHILLIPS:** I think what we've needed for a long time is a long-range goal, which has been referred to by some, including me, as the vision — where are we trying to go — what are we trying to accomplish? Where are we trying to get with our Space Program? I'm thinking in terms of the truly long-range goal, which is measured, perhaps, in two or three decades. I have said a number of times, including earlier today, that I think the long-range goal I would like to see us establish in this country is exploration of the planet Mars with humans; and I say that, because I think it could be worked out in a way that support would truly be generated, and then the set of projects that are required would necessarily include reliable space transportation, and a way to operate in earth orbit, the space station configured in a way that it could be a true planetary or exo-Earth base or space port which the space station could ultimately become. Whether or not activities in connection with the moon are required, I think, deserves some further thought. There are those that feel strongly that it should. I think in that sequence of activities involving both unmanned and manned exploration extending outward, with the long-range goal being manned planetary exploration, that we would be able to generate support for a vigorous Space Program which I believe would contribute to so many of the things that have been talked about here today.

**MR. FINK:** There's an advantage to being last if not next to last. I would go back to what I said in my speech, and build on all of the shoulders of these programs that have been discussed here. I couldn't agree more with Sam; if you want to set the priority for one program, and you're limiting us to one program, I would go as far out as you could possibly go, because all of these other things are going to have to flow as part of that, so, why not reach for Mars, if that is ultimately what we want to do. We needn't set any definitive time schedules, we needn't tie ourselves down to schedules. We needn't say necessarily that we need all of this money now, and we need to crash through with the program. If we have

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that out there, you see that's where we're going, we're reaching for that, all of these other things will flow as naturally as Mercury and Gemini flowed into Apollo. And we won't have a strong rigorous space shuttle system, we will have an established space station program, and from that, will flow these mission-to-earth-type activities, and from that will come all the benefits of mankind here on earth as well as giving us a stepping-off point to the outer planets. From that may well come a permanent base on the moon.

Reach out as far as we possibly can. We can talk about Pluto, but why talk about the ridiculous. Mars is within reach, and it is within reach in the lifetimes of, if not ourselves, then certainly of our children. Go that far, and all these other things will flow. We will build on the shoulders of each program as we go along.

**DR. FORMAN:** The foundation on which everything that has just been mentioned would rest, at least in the United States, is a political constituency in support of the Space Program, which doesn't exist. Do you remember what Jim Beggs was saying? It's absolutely true. There is no political constituency for technology in space in the American body politic, and unless and until there is such a thing, we're going to be staggering along with budget cuts and budget strangulation. And without budgets, you don't get to do any of the other things you want to do.

So if I had one space program, it would be to assemble and raise the money for the biggest, meanest, toughest, richest political action committee, backed up by the richest, meanest, and orneriest letter writing campaign, poised and timed to every step in the NASA budget cycle to snow every recalcitrant Congressmen with letters saying why did you vote this way, and why did you vote that way. That's the way you get to do anything else you want to do, and that's exactly what we haven't done so far. Unless we leave this room and start doing that kind of thing, then we are talking to ourselves.

Politics is where it starts. Money is what makes it possible, and the stars are within our reach, If we start doing our political homework now. End of speech. Thank you.

**MR. MAC LEOD:** Ladies and gentlemen, we thank, every speaker and our spirited moderator as well, for the tremendous job of starting this Fourth National Space Symposium with your provocative comments.

At this point, I'm going to ask if Astronaut Joe Allen, and Gen. Hill might come up to the podium.

**DR. ALLEN:** Dick, we're really following up on an assignment given to us by the moderator today, and instructions given by Jim Beggs before he left. This has to do with science and space having no public constituency.

A group that set out some years ago to do something about that is the United States Space Foundation, which is the reason that we're gathered here today.

I represent a sister organization called the Space Foundation, which is headquartered in Houston, Texas. We've been in existence for about ten years now. It's one of the assignments that I'm very proud of, and that I take very seriously.

The Space Foundation has educational programs, it has outreach programs, and it has space business enhancement efforts, done through a nationwide network of space business round tables. In this sense, we have goals that are very similar to, and also very complementary to the goals of the United States Space Foundation.

I believe it's obvious to most of us here that this is a time when the Space Program needs the efforts of all of us to present our message in the clearest terms possible. We've talked about it several times today, and to that end, it's my great pleasure to join Gen. Hill, Chairman of the U.S. Space Foundation, in announcing that our two foundations will begin immediately to work together to enhance the programs and goals of both our organizations.

Jim, I'm pleased and excited by the prospect of working with you and your great organization in pursuing these common and mutual goals.

**GEN. HILL:** Joe, I thank you, and I'm delighted that we've agreed to do that. I would say to this audience that I think that we will go much further than simply working together. I don't know exactly how to define this at this moment in time, but I'm convinced that we will go further than that. It's our pleasure to work with you, Joe, and to discuss these issues with you. I certainly share the view that we have common goals. We have common objectives, and our views are much the same, and in most cases, the United States Foundation, which I created some years ago, has always had a goal of influencing public policy and trying to find a way of creating a new forum for public debate on issues. We have, in these symposia tried to bring together both sides of each issue, so that a clearer understanding can be achieved.

We do think, Joe, that the time has come for us to band together, and to move forward in a concerted way. We look forward to it, Joe, and thank you very much for coming.

**DR. ALLEN:** Good, thank you.

**MR. MAC LEOD:** That concludes the program for the afternoon, subject to the next part of the Symposium. When you get back, look up in your dictionary, what "Symposium" is defined as, and you'll find that it includes the word "drink". Proceed next door now to Colorado Hall where the exhibits are ready to open. The drinks are available, and we hope the discussion will continue.

# INTERNATIONAL COOPERATION AND COMPETITION
## "THE HOME PLANET"

*Speaker:*
**Robert Shepard**, Manager, Special Markets,
Addison-Wesley Corporation

**MR. MACLEOD:** To start this morning, we have a representative of Addison-Wesley Corporation who is going to talk to you about a project that involved most of the astronauts and cosmonauts, trying to describe something only they know anything about: what the earth looks like from space.

Robert Shepard will explain this project, so as it comes up later in the year, you will have a good familiarity with it. Robert?

*Robert E. Shepard, a native of Fair Lawn, NJ, was educated at the University of Pennsylvania, receiving both Bachelor's and Master's degrees in 1983. he served as a researcher during 1983 and 1984 at that institution, working under a National Institute of Education grant to study the scope of public and private sector training programs in the United States. Since 1984, he has been associated with Addison-Wesley Publishing Company, based in reading Massachusetts, an international publisher of educational texts, training products and books on business, health, contemporary affairs, and general subjects. He is currently in charge of the Special Markets Department, which handles bulk sales of trade books to industry, organizations and institutions.*

**MR. SHEPARD:** Good morning. It's an honor to be addressing so distinguished a group today. I understand this event has been called the World Series of Space. Coming from Boston as I do, maybe that's a mixed blessing. As a baseball town we're long on tradition and high on hopes, and notoriously short when it comes to the World Series. But to carry this metaphor to its logical conclusion, I hope I won't strike out here today. Maybe we can expect the same of our Red Sox this year.

Fred Hoyle wrote 40 years ago, that "Once a photograph of the earth taken from the outside is available...a new idea as powerful as any in history will be let loose." Since that time, 201 men and women from 18 nations have traveled in space, looked back at our planet, felt the awe and exhilaration of that vision and taken pictures.

Addison-Wesley Publishing Company, whom I represent here today, is pleased and proud to be part of the effort of broadcasting that vision, through a remarkable new medium, a book called THE HOME PLANET.

Two years in the making, to be published in October, THE HOME PLANET represents the coordinated efforts of scores of individuals from around the world. In its 256 pages, this extraordinary publication will present 150 color photographs of our planet, taken from outer space. They represent the best photos culled from the space archives of both NASA and the Soviet Union.

**Fred Hoyle wrote 40 years ago, that "Once a photograph of the earth taken from the outside is available...a new idea as powerful as any in history will be let loose."**

As you will see in a few minutes, when I show a brief videotape of some of these photographs, there is a second, less visual component to this presentation that sets THE HOME PLANET apart from all other books about space: quotations from astronauts and cosmonauts themselves, 78 men and women from 18 countries in all. These quotations, taken from personal interviews, articles, and space- to-ground transmissions, are arranged in the loose chronology of a space mission, from prelaunch anxieties to reflections upon returning to Earth, with the full range of experience in between.

In the U.S. edition of the book, available this October, they're presented both in English and in the native tongue and alphabet of the speaker, so that a given page may, in fact, contain passages in English as well as Arabic, Spanish, French, Hindi and even Mongolian, to name just a few.

As you can see, THE HOME PLANET is an international project. To date, publishers in the United Kingdom, France, Sweden, Holland, Spain, Italy and Japan have purchased rights to foreign editions of the book. And truly without precedent is the remarkable working relationship that has developed between Addison-Wesley and the Soviet publisher Mir over the past two years. Mir is our co-publisher for this project, one of the only instances of American and Soviet publishers cooperating to produce a book, and the first time, certainly, that we've attempted it.

While this relationship has not been totally without complications, it has resulted in a book that is a true East-West vision of our planet from space. In fact, there's something remarkable in our ability, made possible largely through the technologies space exploration has brought us, to send parts of a manuscript back and forth from Boston to Moscow, and somehow end up with a finished project.

Those of us who were here yesterday heard Joseph Allen talk a bit about this technology. I'm here to say it actually works. In many ways, this technology has made the production of the book an easier feat than deciphering the typed manuscript we normally receive from authors as close as MIT, a few miles from our offices.

Who came up with this idea for such a sweeping vision of earth? THE HOME PLANET is the first tangible product of the Association of Space Explorers, the international organization of astronauts and cosmonauts founded in 1985 to, and I will quote from their founding statement, "... bring together people who have traveled in space, and to encourage the exploration and use of space for the benefit of all."

Though, I do not speak for the ASE, I can certainly vouch for the book's ability to fulfill another of their goals — which is also one of the goals of the United States Space Foundation — to facilitate public awareness of achievements in the exploration of space. What better way to make the public aware of these achievements than to present them in an entirely new medium, a vision of our earth as something at once foreign and familiar, our place of origin, as we explore other worlds as well as our own. In this, the book is also a celebration of the technologies that have put mankind into space, and which moreover, allow images of space travel to come back to those of us who have not been so fortunate as to explore space ourselves.

I might add that this book has been kept strictly outside the bounds of politics, which is really the only way to approach a project of this nature. It will contain prefaces from Astronaut Rusty Schweickart and Cosmonaut Oleg Makarov as well as an introduction by the distinguished French explorer of inner space, Jacques-Yves Cousteau.

You know, especially to those of us who grew up in the post-Gemini era, space travel is, in many ways, taken for granted. We know it's wonderful, but we can't quite get a handle on what it has done for us. We forget that space exploration has brought us, as a recent USSF publication pointed out, such diverse earthbound technologies as improved weather forecasting, medical applications for laser equipment, and even a reading machine for the blind.

And though we've all seen photographs taken of and from space, those of us who are not intimately connected with aerospace technologies tend to forget that thousands of people in industry, the defense community and government, to say nothing of space explorers themselves, have played a role in making each of these images possible.

The photographs you are about to see all appear in THE HOME PLANET, and most of them have never before been seen by the public. In lieu of presenting everyone in the room with a copy of the book, which is, at this moment, just being printed in Milan, Italy, I hope this video will give you some idea of the scope of the project, and if you will, its soul. And now if we could run the video on THE HOME PLANET.

In the past six minutes, you have seen photographs of the Indian Ocean off Madagascar, the Canary Islands, the tip of Cape Cod in my home state of Massachusetts, the Somalian coast, the Bay of Bengal, and the Himalayas, to name a few. If that isn't scope, I don't know what is.

The words you heard were those of astronauts and cosmonauts from a representative sampling of the countries in THE HOME PLANET. I hope this all whets your appetite, because to be frank, I have an ulterior motive in coming before you today, and that is, as you may have guessed, to market books.

You see THE HOME PLANET is a statement about the human side of space travel and space technology. It's a perfect gift for friends and business colleagues, but moreover, it will be well appreciated by your employees, and while it will carry a cover price of nearly $40, we'll make it available to you, your employees, or your base visitors center at a discount.

We expect THE HOME PLANET to be one of the top gift items this Christmas season and beyond, and we already have plans under way for a gala celebration to mark its publication in late October, a publicity tour by a joint team of astronauts and cosmonauts, and a traveling exhibit of photographs from the book. Press coverage of the project has begun and will be even more prominent towards publication. A major monthly magazine, whose name I'm unfortunately not yet at liberty to mention, will make the book its cover story and Addison-Wesley will be able to make books available about a month prior to publication in October.

I hope you will give some thought to this unique way of broadcasting your own message about what you do as part of the aerospace community. Once again, my thanks for your attention, and to the Foundation for making this very valuable time available to me. Thank you very much.

# PANEL: INTERNATIONAL SPACE PROGRAMS

*Moderator:*
**Richard J.H. Barnes**, Director of International Affairs, NASA

*Speakers:*
**Dr. Alain Dupas**, CNES, France
**Tsugudo Tadakwa**, Washington Director, NASDA, Japan
**Dr. Satish Dhawan**, Director, Institue of Science, India, representing the World Peace Council, Helsinki, Finland

**MR. MACLEOD:** The next feature this morning tends to the international. I want to mention to you first that we did invite two countries to come who did not, in the end, provide representation; the Soviet Union and the Peoples Republic of China. The Soviet Union, as of last Friday, was still telling us from their embassy, that the ambassador had not made a decision as to who would come or when.

The Peoples Republic of China did have the Vice Minister of Astronautics planning to come back again. He was here last year. They have had, as you heard in the news yesterday, a government reorganization, and I had a "heads up" on that about five weeks ago, along with indication that when jobs are being moved, people are reluctant to be away. So, they were invited and we'll certainly invite them again.

We had a similar situation with West Germany. They had somebody tagged to come, and that individual was not identified to us. There was a missed cue somewhere on their side, and we do not have a representative.

We do have an eminently qualified individual to lead the panel this morning. He has been directing the efforts of NASA in international affairs for some time, well known in the community, and very well respected. May I present the moderator for this panel, Mr. Dick Barnes.

**MR. BARNES:** Thank you very much, Dick. I regret the absence of representatives from the Soviet Union and China and from West Germany, all important space players, but I think you have lined up a very good array of speakers for our session this morning that give us great, both geographic and programmatic breadths, and I'm very happy to be able to introduce them to you this morning.

But first let me set the stage for this discussion of international space programs. I would like to refer to a report that was prepared for NASA and published about six months ago. It was prepared by a distinguished panel of the NASA Advisory Council. It was a Task Force on International Relations in Space, headed by Herman Pollack, a former senior State Department official. Mr. Pollack had responsibilities covering international science and technology, including space, and is now a professor at George Washington University. He headed up a very distinguished group that prepared this report for NASA that is a very good, straight-forward, frank, and call-them-as-they-see-them kind of report.

*RICHARD J.H. BARNES became NASA Director of International Affairs in October 1985. In this position, he is responsible for planning and directing NASA's involvement in the international community. Prior to his current position, Barnes had been the NASA European Representative at the American Embassy in Paris, France. Barnes joined the NASA Office of International Affairs in 1961 and served in various capacities, including Deputy Director of International Affairs before his Paris assignment. Prior to NASA, he was affiliated with the Atomic Energy Commission's Division of International Affairs and the Bureau of Ordinance of the Navy Department. Barnes received a B.A. degree from Dartmouth College and a Master of Public Administration degree from Harvard University. He also graduated from the Industrial College of the Armed Forces and served with the U.S. Navy during the Korean War.*

When it was published, this report generated a certain amount of controversy with some of its recommendations. But, of the people in the field who have looked at it, and looked at its analytical content, nobody questions the perceptions that are there. They do something that at least we bureaucrats are very cautious about doing — that is trying to predict the future. They have a very interesting summary of how they see the state of foreign space programs ten years from now, in the period 1995 to 2000.

I would just like to give you a few excerpts from that crystal ball gazing to set the stage, because I think in the space business we always have to be looking to the future. We get caught up near term, and in problems of annual budgets and in meeting the next pert chart deadline. But after all, the space business is all about the future, and from time to time, we have to step back and look at the future. Mr. Pollack and his task force have done us a service by making their own prognostications.

Let me now read you a few excerpts from this, their view of the future.

"The Soviets space effort will be significantly more active and open. Europe and Japan will have established autonomous space programs while continuing to take advantage of cooperative opportunities with the U.S. and the U.S.S.R. Europe, Japan, and the U.S.S.R. will be firmly established as viable commercial suppliers of space transportation with a full range of launch systems.

"Full scale shuttle type capabilities will be available in the U.S.S.R. Europe may well be on its way towards demonstrating a smaller man-rated system, HERMES. The U.S.S.R. Space Science Program will have underway a series of progressively more complex Mars missions. In Europe, the trend of executing space science missions regionally will continue as will national programs in the space applications area where competitive and commercial interests reside.

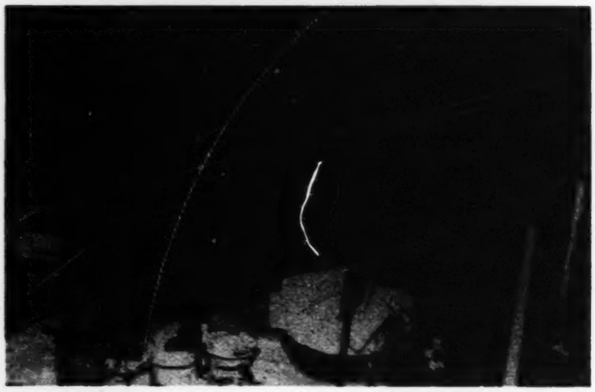
"Japanese industry's competitive posture in communications, direct broadcast, remote sensing and space processing will be the new state of the art. Japan will be pursuing space applications as a priority matter aboard the space station. The Japanese H-2 Launcher will be operational, and their space plane well into design.

"China, India and, perhaps, others will have expanded programs and can be expected to be selling more space wares and services internationally.

The developing nations will continue to find it cost effective to use satellites to meet their communications requirements, and land use planning and other needs. They will be a major market for space systems and services in this period and may be seeking outlets for their own space products."

I think that captures a number of themes that mark the current thrust of space programs around the world, and I hope that it will provide a framework as you listen to the reports of the other speakers in this session that may stimulate some questions for them afterwards.

Let me now introduce the speakers themselves. First up we will hear from Europe. Alain Dupas is an advisor to the Director of Programs in the French Space Agency, CNES.



*DR. ALAIN DUPAS is the advisor to the Director of Programs in the Centre National d'Etudes Spaitiales (CNES), the French Space Agency. His current projects include studies of advanced space systems, and analysis of the U.S. and Soviet programs for CNES. Dr. Dupas joined CNES in 1979. He is the European Editor of the journal "Space Policy." He received his Ph.D. in electronics from the University of Paris.*

Although Alain's focus will be on CNES and the French program, he will also mention broader European activities and will certainly be prepared to answer questions in that particular area. So let me introduce Alain Dupas.

**DR. DUPAS:** Thank you, Dick. It's a pleasure to address such a distinguished audience, and I thank the U.S. Space Foundation for providing me with an opportunity to talk about the French space program. As Dick told you, we are prepared to discuss a broader European space program as well.

The French space program is now 26 years old, and I will try to give you an idea of the programs and the goals of a medium space power, France, working closely with its partners in the European Space Agency.

France became the third space power 23 years ago, in 1965, when it succeeded in launching an artificial satellite by its own means, using the Diamant rocket, which was, in a lot of ways, a predecessor of the successful Ariane rocket. Incidentally, there was a successful Ariane launch a few weeks ago. There will be another one launched in the future, and after some problems, the program now seems to be on the right track from a technical point of view, and as you may know, even when it had some trouble, it was a success from a commercial point of view. I will comment on that later.

Until very recently, France was the only country in the world, besides the United States and the Soviet Union, with its own space agency. CNES, the Centre National d'Etudes Spatiales, was established in 1962 by the government of General de Gaulle. Its primary role is to propose and implement French space policy, but it should also manage space programs conducted by industry, operate space systems, provide guidance and means for scientific research, and so on. The French space program involves many other national organizations beyond CNES. First, industrial companies: we have about 50 of them, and these companies are now able to build rockets and application satellites totally autonomously. I must add that CNES is also creating or participating in dedicated space companies, providing different services. Today, there are about 20 of them. This is one of the main aspects of the French space policy today: to create dedicated companies to promote new space services, like Arianespace for exploiting and selling our satellite launchers; Spot Image to sell images from the SPOT, Interspace for space testing, and so on. There is also in France a strong space science community with about 10 specialized laboratories, more than sixty research groups. One of the main tasks of CNES is to provide support to the scientific community in order for it to be able to participate in very large cooperative international programs.

We have now in France about 7,000 people working on space projects.

France is a member of the European Space Agency (ESA), and CNES has very strong connections with ESA. About one third of our budget is going to ESA programs, and at the same time, about one third of the ESA budget is represented by the French contribution. The size of the European work force on space is about 20,000 people. The European space industry is working for national agencies, such as CNES, the European Space Agency, foreign customers, and space business is becoming quite strong in Europe. I think that nobody in Europe would contest the fact that France is one of the main driving forces behind the European space program, and the European launcher, Ariane, is a good example of this particular role since it was promoted by France as early as 1972. I will come back to that later.

The French space budget is about six billion francs, which is slightly more than one billion dollars today, and it's growing quite quickly. This budget reflects a policy which tries to balance different ways to conduct a medium space program. A large share of the budget goes to multilateral cooperation, which means participation in European programs. However, France is keeping a large share of its space budget for bilateral cooperations, mainly for scientific cooperation with the United States and the Soviet Union. Cooperation with NASA in the recent past has, for instance, included the flight of the French astronaut, Patrick Baudy, aboard the American space shuttle Discovery in 1985.

Another important U.S./French cooperative space venture is the Topex/Poseidon project of an oceanographic satellite to be launched at the beginning of the next decade by an Ariane rocket.

**The French space budget is about six billion francs, which is slightly more than one billion dollars today, and it's growing quite quickly.**

The same will to build a balanced program is also apparent in the way the budget is allocated to different kinds of space activities: science, research and development, launching systems and application satellites.

I want to stress here the fact that France is considering scientific programs and basic studies as the core of its space activities. The quest for knowledge stays at the heart of space activities, and research and technology activities are the foundation of future successes in space science and application. The challenge of research in space provides an impetus for large international cooperative ventures and advanced technology.

Another permanent feature of French space policy is the commitment to autonomy for launching of application satellites. This commitment is at the root of the Ariane project, which, as I said before, is today a very real commercial success. You will hear more about that this afternoon, in the session on competition in the launching systems.

The main workhorse of the Ariane series today is the Ariane 3 launcher, which is able to launch one large, or two medium communications satellites. As you may know, the Ariane launcher was specifically conceived for launching payloads in geostationary orbits, and this is probably one of the main reasons for its success. However, next June, a new version of Ariane will be tested: Ariane 4, whose modular design makes it possible to adapt its payload to the need of customers. If the first launching of Ariane 4 is successful, Ariane 4 is to become the workhorse of Europe in the competition for launching systems, until at least 1995, and probably into the last years of the next decade.

A large effort is also devoted in France to application satellites. The Telecom 1 domestic telecommunication system is operational and provides intercompany links, governmental links — that means, in particular, that it is used by the French Ministry of Defense (with the Syracuse communication system). It also provides telephone, telex and television links between Metropolitan France and overseas departments and territories.

We also have a very strong program in direct broadcasting. This program is conducted in bilateral cooperation with Germany. A first satellite, TVSAT was orbited by Ariane last November, but failed soon after reaching orbit. The French version of the satellite, TDF 1, will be launched in October, and the replacement for the TVSAT satellite, TVSAT 2 will be launched in 1989. This could bring a whole new era for television in Europe. France has been also very active in remote sensing with the SPOT program. The first SPOT satellite was launched a little more than two years ago. It is still working, and its successor, SPOT 2, is ready for launch if needed. The development and the building of SPOT 3 has been decided. It is thus really a program intending to provide continued service, at least for the next ten years. You will probably hear more about SPOT and its capabilities on Friday morning in the session about earth observation. The SPOT platform will be used also by the French Ministry of Defense to build a military reconnaisance satellite, Helios. So with the Helios program on its way, and with the Syracuse telecommunication program, the French military space program is growing quite quickly.

The Helios spacecraft is to be launched around 1993, and of course, it can provide high resolution pictures compared to SPOT. The military space budget in France, managed by the Ministry of Defense, with technical support from CNES, is now reaching about 3 billion francs, which is about $500 million.

Two countries, Italy and Spain, have joined France in the development of the Helios satellite.

I have mainly talked here about national space activities and about programs conducted in bilateral cooperation. However, a lot of our successes in space, of course, come from cooperative programs inside the European Space Agency. These programs cover science applications and also, of course, launchers, since, as I told you, the Ariane program is a European program.

A few years ago, there was for instance the first flight of the Spacelab laboratory, with participation by Europe in the American Space Transportation System Program. It's a valuable tool for a lot of research. And even if it was not exactly what Europeans would have liked it to be, it was at least a very great technical success, and we learned a lot in being involved in that program.

Also the European Space Agency is conducting a very strong science program, and I want just to remind you of the success of the Grotto spacecraft, passing by Halley's Comet in 1986.

We can also quote the METEOSAT program which was at the beginning a French program, but became a European program, and is now fairly operational. It is a meteorological program and is exploited by a special European entity called Eurretsat.

For the future, there is the EURECA platform, which will be launched and retrieved by the American shuttle. Its first mission will be devoted to microgravity research.

There will also be a satellite for earth observation - ERS-1, which will use the same platform as the SPOT spacecraft, but with a new payload: synthetic aperture radar, mainly for oceanography and for looking at marine resources. It is to be launched at the end of the decade.

The ESA scientific program is also going on very strongly, for instance, with the ISO infrared space observatory, which is to be launched at the beginning of the next decade. And I can cite also, for instance, participation of ESA in the NASA Hubble space telescope project, which we hope will be launched next year. If you have any other questions about the ESA program, I am prepared to answer them later.

I've told you about what we are doing in France, and somewhat in Europe, for science application and launching systems, but now Europe has a new goal, which is to attain autonomy for manned space flight. The goal is very strongly established: the European Space Agency Council, which convened at the ministerial levels in Rome in 1985, and then in La Haye a few months ago, have endorsed this objective.

**Europe has a new goal, which is to attain autonomy for manned space flight.**

The fundamental reason behind this decision is that we think, in Europe, that new space applications, using the presence of man in orbit, will open up important fields for the technical and economic exploitation of space.

Also, the possibilities of human intervention in space may have a considerable impact on scientific and technical programs, for instance for servicing large observatories, in-orbit assemblies of heavy spacecrafts, deployment of large structures, and so on.

Also, discovery, exploitation and utilization of space by human beings, in our view, could be one of the prime undertakings of major powers in the next century.

The programs that were approved at the European levels include the development of a new space transportation system. This new space transportation system has two parts. The first one is a new, more powerful automatic launcher, Ariane 5.

We found in France and in Europe that after Ariane 4, a new, more powerful launcher was needed in order to follow the growth of payloads for telecommunications and other applications. A strong need was also apparent for a more reliable and less costly launcher. A new launcher was needed, and Ariane 5 was first of all designed as a follow-up of Ariane 4, in order to keep or reinforce the position we hold in Europe in the launching market. But it happens that the specifications for an advanced launcher of unmanned satellites are very nearly the ones you need for a launcher carrying a manned spacecraft, particularly in terms of payload and reliability.

This leads to the concept of the Space Transportation System combining Ariane 5 and a Hermes spaceplane. This combination can carry out launching of both automatic satellites and manned space flights, although the two operations are completely separate. You can't call

Hermes a mini-shuttle. It does not have the main propulsion system, which the American shuttle has. It's simply a particular payload of Ariane 5, able to ferry astronauts and some payloads towards the space station. It is also much smaller than the U.S. shuttle.

**You can't call Hermes a mini-shuttle. It does not have the main propulsion system, which the American shuttle has. It's simply a particular payload of Ariane 5, able to ferry astronauts and some payloads towards the space station.**

Ariane 5 will have a payload in low earth orbit of about 45,000 pounds, which is the mass of the Hermes Spacecraft, and the payload launched toward the geostationary orbit will be about seven tons, which will be enough to launch two heavy telecommunication platforms, which is once more the main mission for which Ariane 5 is designed. The first launch of Ariane 5 is planned now for 1995; it will be, of course, unmanned with automated payloads. The first flight of Hermes spacecraft is planned for 1997, and we think that this first flight will be done without an astronaut on board. It will just be a test, and the first manned flight of the Hermes spaceplane could happen in 1998.

The main mission of the Hermes spaceplane will be to service the MTFF, that means the "man-tended free flyer," which is a part of the COLUMBUS program. MTFF is to be launched around 1996. The MTFF is only a part of the Columbus program which is to be the participation of Europe in the international space station but it is the autonomous part of this program, and we think that the MTFF will later lead to a truly autonomous European space station. The Columbus program includes another part which is very important for us here today: the APM, the "attached pressurized module," which is to become one of the permanent elements of the international space station which we hope will be operational sometime around 1996.

In Europe, we have thus now three large programs beginning: The Hermes spaceplane, the Ariane 5 launcher, and the Columbus space station program.

For Europe, in particular, the Hermes program is a very strong technological challenge, which we think will make European industry and European technology progress in a lot of technologies.

France and the other European country members of ESA — there are thirteen countries in ESA now — have learned over the years to work together, to cooperate with other countries, mainly with the United States, and the drive, which you can feel now toward total autonomy in space in Europe is not directed against anybody. It is intended simply to make Europe a major actor and partner in the large-scale space activities, which we believe are to take place at the beginning of the next century.

I thank you very much for your attention.

**MR. BARNES:** Thank you, Alain, for that very interesting and comprehensive report on the CNES program and how it fits overall in Europe's current space programs and activities. I certainly agree with you that France has been a major driver of the European Space Program directions and capabilities.

Those of us, like me, who have dealt with CNES since it was established in 1962, have always admired its effectiveness and that admiration has a certain tinge of envy. CNES always seemed to be able to deliver top level political clout from the Elysees Palace whenever that was required. Whereas in the U.S., inter-agency disputes on priorities, on monies, always seem to be conducted openly and rather bloodily in the press. These disputes, to the extent they occur in France, seem always to be resolved discreetly behind closed doors. France always presents to the outside world a very unified picture even between the government and the private sector.

I think that this is illustrated by the fact that the Director General of CNES, the Number 2 position in the agency, wears a second hat as the Chairman, the Number 1 position of Arianespace, the private sector organization, which is one-third owned by CNES. CNES is responsible for the commercial exploitation of Ariane. That sort of two-hatted arrangement would be impossible in the U.S.

Our next speaker is a colleague of mine, temporarily at least, in Washington. Tsuguo Tadakawa is the Director of the Washington office of Japan's Space Agency, NASDA. Mr. Tadakawa received an MS degree in applied mathematics from Waseda University, and he joined NASDA in 1970, which is very shortly after NASDA was originally established. For thirteen years he was in charge of the system design and flight kinetics, guidance and control of first the N series of launchers, Japanese launchers that were based on the U.S. Thor Delta, and then subsequently the H-1 launcher, which builds upon the N system, and is the current launcher that's being used in Japan looking towards a transition early in the next decade to the H-2.

In 1983, he moved to the NASDA International Affairs Office where he was in charge of international cooperation, and he is now the Director of the Washington office in NASDA. Mr. Tadakawa studied guidance and control at the Department of Aeronautics and Astronautics at MIT from 1974 through 1975.

To tell you about the very important developments going on in Japan now, which has already arrived on the scene as one of the major space powers, it's a pleasure to introduce Mr. Tadakawa.

**MR. TADAKAWA:** Thank you very much, and it is my great honor and a pleasure to participate in the Fourth U.S. Space Foundation Symposium and to speak about Japanese space activities.

*TSUGUO TADAKAWA, after receiving an M.S. degree in Applied mathematics from Waseda University, joined the National Space Development Agency of Japan (NASDA), in 1970. He was in charge of system design, flight kinetics, guidance and control of N series and H-1 launch vehicles for 13 years. He worked in R&D efforts, especially the Japanese future launchers for 13 years. He was assigned to the International Affairs Office and was in charge of international cooperation. He studies guidance and control at M.I.T. from 1974 through 1975. Since July, 1986, he has been Director of the NASDA Washington Office.*

Eighteen years have passed since Japan launched the first artificial satellite called "Ohsumi" in 1970. During this period, from 1970 to 1988, I believe Japan's space activities have made steady progress in our space program technology and budget.

In the scientific field, Japan has contributed to the international scientific society with 12 scientific satellites such as "Sakigake," and the "Suisei," and it's occupied a unique position in the Halley Comet program.

In the application field, our technology capability has been successfully developed, and demonstrated in launch vehicles, communications, broadcasting, meteorological, and earth observation systems.

The Space Activity Commission, SAC, the advisory organ to the prime minister, has played the role of making space policy in the area of space activities in Japan, and released the space development plan which is updated annually. The principal organizations to execute these programs, described in the annual space plan, are the Institute of Space and Astronautical Science, we call ISAS, and the National Space Deveopment Agency of Japan, NASDA, my agency.

ISAS, supervised by the Ministry of Education, Science and Culture is in charge of the space science field. NASDA, established by a law in 1969, is in charge of the field of the practical applications under the supervision of the Science and Technology Agency, Ministry of Posts and Telecommunications and Ministry of Transport.

The Ministry of International Trade and Industry, MITI, has shown an interest in space recently and is trying to promote such a commercial space activity that will not totally depend on the government budget to expand involvement and investment by the private sector.

In fiscal year 1988, just beginning in April, the government's investment in space is 141.8 billion yen. That's about $1.1 million. Besides the government's investment, NASDA will have 16.8 million yen of income from the users, such as JMA which is a part of the ministry of transport, Nippon Tellegram & Telecommunication, and Japan Broadcasting Corporation.

**Japan will carry out our space activities by four major principles. One is to carry out the space activities solely for peaceful purposes; second, to promote space activities in harmony with the social needs and national resources; third, to promote a technologically autonomous capability; and fourth, to promote international cooperation.**

The total budget allocation given to NASDA is about 72.5 percent with ISAS and other agencies about 8.5 percent and 19 percent respectively.

The forecast of the Japanese space budget is to be 10 percent of the total worldwide space budget.

The Space Activity Commission set forth a "Guideline of Japan's Space Activities Policy" in 1978, and revised it in 1984, and is now updating a new guideline toward the 21st Century. Based on the current guideline, Japan will carry out our space activities by four major principles.

One is to carry out the space activities solely for peaceful purposes; second, to promote space activities in harmony with the social needs and national resources; third, to promote a technologically autonomous capability; and fourth, to promote international cooperation.

The H-2 rocket and the ETS-6 satellite are a good example of our capability, whereas participation in the international space station, international scientific program, et cetera, are part of our international cooperation.

I do not work for the ISAS, but I will give a brief explanation of the ISAS activities. ISAS has conducted a scientific satellite program, and contributed significantly to the science community, such as in the Halley Comet program and the discovery of supernova by "Ginga." The Mu-series launch vehicles, developed and operated by ISAS, are all solid propelled rockets for scientific missions. Up to the present, ISAS has launched a total of 17 scientific and engineering test satellites from Kagoshima Space Center.

The newest M-3SII rocket, a three-stage solid propellant vehicle, launched the explorers for the Halley Comet and the x-ray astronomy satellite.

ISAS plans to launch EXOS-D for physics in the auroral ionosphere, Geotail for earth's magnetotail observation, Solar-A for x-ray observation of the sun and Muses-A for the lunar swing-by experiment.

On the other hand, NASDA has successfully developed the N-I, N-II and, H-I rockets by combining imported technology with indigenous technology and launched 24 satellites, without failure.

The recent launch of CS-3a took place last February. In our H-I rocket, we developed a second stage cryogenic engine, LE-5, inertial guidance system and the 3rd stage solid rocket motor. NASDA is now developing an H-II rocket with our technology. The H-II rocket is a two-staged vehicle augmented by two large solid rocket boosters capable of launching 2-ton class satellites into geostationary orbit.

The main purpose of building the H-II rocket is to meet the domestic demands in 1990s and to establish indigenous launch vehicle technology.

The first test flight of the H-II will take place in early 1992. Launch cost is expected to be comparable with the Ariane and the U.S. space shuttle. LH/LO propulsion systems are used in both stages. The first stage engine, LE-7, is a stage combustion cycled engine, like SSME, and is crucial to its development.

We are now conducting an engine system firing test with prototype component after overcoming the various difficulties such as turbopump rotor whirls, turbine blade cracks, and combustion chamber erosion.

The first full scale solid rocket booster firing test will take place on the 15th of this month.

The new launch site for the H-II rocket is being constructed in the Tanegashima Space Center.

Now under way is HOPE, the H-II Orbiting Plane, launched by H-II or its upgraded version, to supply/recover goods or materials from/to the space station.

On February 19th, 1987, NASDA launched the first remote sensing satellite, the Marine Observation Satellite Number 1 with three sensors. Now MOS-1 data is re-received in eight stations in the world and distributed to the public on a discriminatory basis.

The follow-on to MOS-1, called MOS-B, will be launched in 1990.

The Earth Resource Satellite-1, ERS-1, will carry synthetic aperture radar (SAR), and two optical sensors, has 18 meter spatial resolution, and will be launched in 1991.

Japan recognizes the importance of continuity in the earth observation program, and has responded to the various needs of domestic and foreign countries by strengthening international relations in the earth observation program, and has made a decision on the development of Advanced Earth Observation Satellite (ADEOS), and the participation in IPOP with two sensors.

NASDA announced the solicitation of proposals for one sensor of ADEOS. A foreign-made sensor will be on board ADEOS.

Japan, as well as other countries, recognizes that space can be used as the place where new materials, semiconductors, and so on, can be produced. Material processing in space, by using the small rocket which we flew in the past, demonstrated this fact.

Now under way are the First Material Processing Tests, FMPT, SPACELAB program, a Space Flier Unit (SFU, a Japanese free flier), and participation in IML-1 and 2. FMPT (SPACELAB) will be launched by the space shuttle in May of 1991, according to a current space shuttle manifest. The first Japanese Payload Specialist will be on board the space shuttle on this mission.

The SFU, which weighs about 3.5 metric tons will be launched by H-II rocket in 1993, and it will be recovered by the U.S. Space Shuttle. The SFU is a joint venture of the MITI and ISAS, and NASDA for astrophysics, material processing from the government sector and private sector, and preparatory tests for exposed facility of the Japanese experiment.

Of course, Japan will participate in the international space station with a Japan Experiment Module (JEM), which consists of a pressurized module, an experiment logistic module and an exposed facility, and which accommodates general science and technology development functions.

Where is Japan going? Last May, a long-term policy council under space activities commission released its report on what Japan's space development should be for the next 15 years. The report recommends to Japan, the infrastructure with JEM as its central part, and Japan's undertaking of manned space activities.

From now until the middle of the 1990s, ETS-VI and the H-II rocket will be developed, and the JEM will be launched as a part of this Space Station.

Second, from the last half of the 1990s into the beginning of the 21st Century, the operation of the Space Station and development and operation of the Japanese infrastructure around the Space Station will be advanced. This will promote manned space activities and encourage the space industry to become self-supporting. Lunar and planetary exploration will also start. According to the cost projection of the report, our government is expecting to invest $40 billion for the next 15 years to achieve the above recommendations.

The Japanese DTRS satellite forms a data relay worldwide network to combine the Japanese DRTS satellite, and the U.S. TDRS and the European DRS satellite. DTRS is one part of the Japanese space infrastructure.

Someone said that ADEOS is wrongly named; it means goodbye to the U.S. and Europe. On the contrary, Japanese is trying to strengthen international relations. ADEOS is its symbol.

The U.S. and Europe, of course, as a whole, are countries big enough to be autonomous.

On the other hand, Japan has little land, scarce natural resources, but we have the technology and the capability to develop or innovate it.

So, I believe that the Japan space activities go towards a combination of autonomy and international cooperation.

I conclude my speech by saying that the time has come when the Japanese will contribute to the world by our technology.

Thank you very much for your attention.

**QUESTION:** If technology transfer issues worked out, would Japan be interested in buying a space shuttle system from the U.S.? Would NASA consider sale of the Shuttle to Japan?

**MR. TADAKAWA:** To my best knowledge, the space shuttle is too large in size and operational cost for Japanese space activities in the near future. I don't know whether NASA will sell the space shuttle to Japan. It seems to me to be a highly political matter whether Japan buys it.

**QUESTION:** Is an international organization (perhaps modeled after INTELSAT) practical for remote sensing of the earth from space?

**MR. TADAKAWA:** Remote sensing of the earth from space has been discussed in the United Nations. I don't think an international organization only for remote sensing needs to be established, because each country has its own requirements and views on remote sensing which enable us to find a common ground with difficulty.

**MR. BARNES:** Thank you, Mr. Tadakawa. I think that was a very interesting expose of a growing program that is significant, not only in terms of its autonomous activities but its growing international dimensions.

It gives me special pleasure to introduce the next speaker. I haven't seen him for ten years, until this morning, but I first met Professor Satish Dhawan when he was the Director of the Indian Institute of Sciences in Bangalore.

Just as Andy Stoffan, the retiring NASA Associate Administrator from Space Station, said when he came to headquarters from the Lewis Research Center: "I've just given up the best job in the world." The Director of the NASA Center is considered within NASA to be one of the best jobs in the world, and I think Professor Dhawan felt he had the best job in the world as the Director of the Indian Institute of Science in Bangalore. But following the untimely death of Vikram Sarabhai, one of the founders of the Indian Space Program in the early 1960s, Professor Dhawan was literally drafted by Mrs. Gandhi to come in and become the head of the Indian Space Research Organization.

While he was personally reluctant to leave the comfortable and rewarding life as Director of the IIS, over the next 12 years, from 1972 to 1984, he provided a firm and steady hand in managing the development of the Indian space program through a very critical transition phase from the very early beginnings of sounding rocket programs to what has become, in the 1980s, the leading Third World space program. With a program the size and magnitude that India has, it is in the same category as any other space program in the world. It has major dimensions in all areas, including a growing involvement in manned space flight.

Professor Dhawan was educated initially at the University of Punjab in India. He has an M.S. degree in aeronautical engineering from the University of Minnesota, and a Ph.D. in aeronautics and math at Cal Tech.

At the time he was drafted to become head of the Indian space agency, he was a visiting professor at Cal Tech, so you can see he has very strong ties to the U.S.

Currently he is "retired," but if you believe that that really means retired, you're wrong. He continues as a member of India's Space Commission, which is the Board of Directors for the space program, and he's Chairman of the Governing Council of the Raman Research Institute.

It's a real coup for the U.S. Space Foundation to have invited him to address this group. Professor Dhawan?

**DR. DHAWAN:** Thank you, Mr. Barnes. I'm delighted to see you again. Distinguished delegates, ladies and gentlemen, it's a real pleasure for me to be with you this morning. I'm grateful to Richard MacLeod, the Executive Director of the United States Space Foundation, and to Romesh Chandra of the World Peace Council for making it possible for me to attend this distinguished Symposium.

Twelve years from now, the population of the world entering the 21st Century will reach six billion people, an increase of one billion. More than half of these people will be still living at near or subsistence levels. All six billion will need food, shelter, protection from disease, and at least availability of water, food, energy, agricultural, industry and a global production - distribution system which, if not entirely equitable, may, at least, provide functioning in a manner so that the primary wants are met.

Space technology has already demonstrated unique capabilities to assist in these tasks. The global economy and the nature of the international society are changing rapidly. It's no longer possible for the old ideas of imperial and colonial hegemony, in whatever form, to shape the world.

Political events and social urges towards freedom

*DR. SATISH DHAWAN'S experience in the Indian space community is extensive. He joined the Indian Institute of Science in Bangalore in 1951, and was its Director from 1962-1981. In addition, from 1972 to 1984, he was the Secretary to the Government of India for Space, the Chairman of the Space Commission, and the Chairman of the Indian Space Research Organization. From the University of Punjab, he received a B.A. in Physics and Math, an M.A. in English Literature and a B.S. in Mechanical Engineering. He continued at the University of Minnesota, receiving an M.S. in Aeronautical Engineering, and received his Ph.D. in Aeronautics and Math at Cal Tech. Dr. Dhawan, now retired and living in Bangalore, is a Foreign Fellow of the U.S. Academy of Engineering, a Fellow of the Indian Academy of Sciences, a member of the Indian Space Commission and Chairman of the Governing Council of Raman Research Institute in Bangalore.*

and a civilized life, and the spectacular development of modern science and technology have nudged mankind and the planet it inhabits into a kind of global commonwealth. To be sure, dissensions and conflicts persist in the world. They persist between nations, and some of them within nations. It is, however, increasingly being recognized that if mankind and the world are to survive and fulfill its destiny, these conflicts would have to give way to a more civilized and workable sharing of ideals. Resources and organizational patterns must be developed to sustain this.

The present world economic situation can be categorized by three main features:

The growing inequities between the North and the South; the growth of world output and trade is slowing down alarmingly; the instabilities and uncertainties in the international economic system are fueled and amplified by the astronomical expenditure of armaments.

The global arms trade not only fuels internecine conflicts, but it also diverts the scarce resources away from peaceful development.

The paradox is that the developing world, where most of humanity resides, provides an enormous potential market for all kinds of goods and services. Curiously enough, the technology for all this exists today; one can feed, clothe and shelter everyone on the globe.

**It seems to me that it would be extremely shortsighted for any one nation, or any group of nations to look at the issue of space and its use from a narrow and restricted point of view.**

It seems to me that it would be extremely shortsighted for any one nation, or any group of nations to look at the issue of space and its use from a narrow and restricted point of view.

The space balance sheet must contain a world view, must include the economics, the security, the scientific and cultural, the preservation of the ecological balance, and the reduction of North/South disparities. It must include the aspirations of the most advanced, as well as those of the developing and the deprived countries. Space offers a unique arena where conflicting aspirations and past predilections of nation states can take a back seat to where cooperation is inherently natural and logical, where there can be exhilaration in fulfilling the dreams of pioneers from all lands.

In the long run, no nation or group of nations can hope to survive by turning their back on the knowledge created by modern science, and of the application through technologies which are essentially the conversion of scientific knowledge into products, processes, and the new way of doing things.

Neither can any nation afford to ignore altogether the problems of those who, because of history, today find themselves without the dignity of civilized life.

Paraphrased, when the bell tolls in space, it tolls for everyone on earth.

The sustenance and transformation of the global economy is already totally dependent on what are essentially information transactions. The application of space systems has rapidly transformed the manner, scale and the timeliness with which information is gathered, transmitted, utilized and interpreted. The weather, resource data, the state of the environment, telecommunications, and television and many other areas are demonstrating the worldwide application value of space. A multi-billion dollar world market for space technology and its applications has rapidly emerged as a reality.

**When the bell tolls in space, it tolls for everyone on earth.**

Space scientists have viewed space spectacularly to glean new scientific information and added immeasurably to mankind's knowledge of the origin and evolution of the solar system. New applications are rapidly evolving and coming into profitable uses apart from satellite communications and remote sensing.

These new areas include search and rescue, disaster warning, mobile communications on sea, land and the air, direct broadcasting, and micro-gravity conditions which permit experiments and processes, which may subsequently prove to have critically important applications on earth, are coming into being. The eventual industrialization of space — still a gleam of the eye, and some way off in the future, we also get on with the very important years to come.

All these are emerging to satisfy the social and economic needs of not only the advanced countries, but potentially, even more so of the developing world, which comprises nearly three-fourths of humanity and who see, in space, a means, a real means to leapfrog into the modern age from centuries of stagnation.

Permit me to briefly draw your attention to some activities in India. A developing country with a very large population; inhabiting a subcontinent; peopled by diverse communities; amalgamated by a historic civilization, going back over 25 centuries. But today, with a per-capita income of less than $300, India is struggling to modernize and to provide and secure a civilized life for all its people, and using, as best as it can, the two most prized and hallowed gifts developed by man political freedom for all its citizens and modern science.

Choosing to remain non-aligned in geopolitics, committed to cooperation between nations and the ideal of peaceful settlement of disputes, but quite prepared to defend its own freedom, India elected 25 years ago to harness what, at that time, was only a potential promise of space technology, and to see whether it could use it to aid the development of India.

In this effort, which has had its ups and downs, the Indian space scientists and engineers have received extraordinary encouragement and active support from the scientists and space agencies of many countries — NASA; the U.S.S.R. Academy of Sciences; the Intercosmos Council; CNES, the French Space Agency; the West German space agency, the DFLVR; and last but not least, the European Space Agency, and also many individuals, outstanding scientists from these countries.

Notwithstanding the vicissitudes of geopolitics, it is a tribute to the single-minded effort of the Indian space scientists on one side, and the essential wisdom and cooperation of international space, that India could, step by step, learn to design, build its satellites, and launch its systems and put them to use.

Today, INSAT, the national multi- service system, is in the fourth year of its operation. The spacecraft was built in the United States, launched by the shuttle IRS; the first operational remote sensing satellite built in India went into orbit on March 17th, less than a month ago, launched by a Vostok launcher from Baikonur Cosmodrome. All elements of the ground segment and their utilization, for both the space services, were designed and built within the country by the Indian Space Organization.

This slide is the Indian National Satellite Telecommunications ground segment. Less than five years ago, these 300 earth stations didn't exist. India has about a 25-30 year old telecommunications system based on cabling, microwave links and all the rest, but there were large areas of the country, particularly the northeast, the islands, and up in the northern regions of the Himachals which weren't blessed with any communications. I don't have to tell you what communications means to the modern country.

Since being put into service, the Indian National Satellite System on the communication element provides 4,000 speech circuits over 85 routes covering the subcontinent.

There are 127 terminals of a National Data Information Network, which brings to the capital of India, Delhi, information from hundreds of central governments, and departments of the states, which constitutes the public system in the country. This data, both economic as well as other primary information on which the national government can be able to see this, annually hold budgets, as well as problematic.

There is a newspaper facsimile service, just starting, which would provide 5,000-odd newspapers; a part of them are in individual languages and facsimile services.

A new telegraphic network in the northeast region, which I mentioned before, consists of 50 stations. Nothing existed there before; not even the pigeons could fly. People had to walk on the ground, up the hill, down the hill, and sometimes the information did get to Delhi.

The new telegraphic network is modernly more efficient than the national communication systems. With a great deal of education, the public will say, "How come we can speak and send telegrams to people in our villages in northeast, but we never hear from Delhi?"

1988 is already accomplished. When the SITE system went up, there were eight terrestrial transmitters in the whole village, and they were located in major centers, Delhi, Bombay, and Madras and one or two other places, and only a few TV sets.

Today, there are 220 TV transmitters serviced by a satellite. There are 6,000 community sets in the rural areas, what Dick Barnes mentioned, the hallowed SITE experiment. Personally, I think, I regard that as a failure of our system, if we haven't covered a hundred thousand villages but only 6,000.

The community sets are unique. They are not personally owned, but they are owned by the community, and they are used by the community as a group, between 50 and 100 people, as we learned during the SITE experiments in the '70s, we began with men sitting in front; then came women next, and children last. And in a month's time of viewing, the position changed — the men went away, the children were in the front, and the women were the ones who learned from the TV how to look after their babies, how to cook better, what it means to have an evening which was not drudgery, but was interesting.

The TV ground segment provides regional feeds for language broadcasts. There are only three so far. India is a country of many languages — 56 of them are enshrined in the Constitution as officially to support, generate, very large numbers of people who do speak more language than one, and hopefully, the regional feeds for every broadcast very soon will cover at least five major regional areas, so that we not only hear from what Delhi has to say in English, and in Indi, but you can speak and hear your own language.

There are six channeled radio relay networks covering 98 stations.

Finally, there are meteorological services. The INSAT system, the multi-service system, carries the Telecom, the television and radio, meteorology and a disaster warning system. Every half hour, the Meteorological Department of India receives full scan INSAT photographs and also sector scans; provides wind speeds and other data for the national meteorological forecasting service, invisible infrared systems.

There are approximately 25,000 pictures that have been taken so far. There's a lot of research possibilities for it.

It's interesting, the statistics now being gathered in the country show, just in the last four years, what meteorological forecasts are beginning to mean in economic matters to the economy of the country.

The next picture, I'm going to show you is the IRS satellite, which was launched on March 17th. Here is the first picture, 17 meter resolution by the CCD camera, the low resolution camera of the satellite. The picture shows you a part on the east side of India, near the Bay of Gudur, just north of the City of Madras. In the lower right-hand corner, you will see an island-like thing. That is India's National launching range. It's really — I won't dwell on it, that fact that the pictures are already becoming rapidly part of the National Remote Sensing System which has been in the offing for the last seven or eight years.

This picture shows you another one, more higher resolution, a 30-meter resolution camera on the satellite, shows you the famous River Ganges. The picture is near the town of Bisalpur, just south of the Himalayan foothills. I picked it up, because it shows Baldoff with which river the history of the country's evolved for many thousands of years. The IRS-based Natural Resources Management Service, which is just getting into operation, along with the INSAT services, will constitute the two major space services which have been planned and steadily worked for, for the last 20-odd years. Incidentally, that tells you how long it takes to utilize in space.

Apart from the revolutionary telecommunications, radio and television, and meteorological services which INSAT has already brought about, the IRS system will provide the backbone of the newly organized National Resource Managing System. Every year the planning commission of the government of India has to determine what the procurement price of wheat is to support the farms, wheat, rice, other major agricultural products. The first base for that is to know how much there is going to be, and in the past, this has been plus or minus, give or take 20 percent. You can realize what the LEO system is for, the National Source Managing System that can provide just that one single point to the planning commission.

The accuracies will improve. We have done experiments using the LANDSAT and SPOT for many years, significant improvements with about 5 percent accuracy. This is a dramatic change in determining how much resources in food/grain countries have.

There are many others: Agricultural, forest, industry, watering sources and all of that. I will not go into detail.

During the '90s, the INSAT-1 Space System will begin to be refurbished by the larger Indian-built spacecraft, which will replace the U.S. space systems. Two of them are co-located, and the third in-orbit spare.

The IRS system, the remote sensing system, is expected also to undergo very rapid evolution to meet the rising demand by users for higher evolution, day and night capability, and the ability to acquire information during the monsoon months, that's through cloud cover, essentially means microwave systems.

Both space systems are expected to pay for themselves within five years. The INSAT system, which is just getting into the fifth year, has already earned enough revenue to pay for entirely the building of the spacecraft, the launch system, the deployment on the ground.

This, I think, by any standards is a remarkable feat for a developing country.

The Indian launch capability is expected to steadily grow from a very modest 150 kilograms in lower earth orbit to about 1000 kilograms in sunsynchronous polar orbit; the ability to launch IRS satellites by 1990, and then a few years later, to place INSAT class satellites in geo-synchronous orbit.

The entire program is application driven, but there is a modest, nevertheless serious, component of science. The Indian Space Research Organization, the Indian agency responsible for executing the program, is currently preparing a program profile for the next decade, 1990-2000. This aims to consolidate the current operations of space systems; expand the utilization; introduce new services, and lay the industrial foundations for integrating the Indian Space Services into the main stream of national life.

The program is now reaching a stage where India can begin making modest contributions to international space.

The next ASLV launch from SHAR range, which hopefully will come off in June, contains a payload developed by DFVLR. It is a monocular optical space sensor, cooperatively being launched on the ASA, from a lower range for the German space agency.

The ISRO shares program which has been operational now for the last three years extends facilities for training and work in space sciences and technology, to scientists and engineers of other countries, particularly, those who come from developing countries. Approximately 25 to 30 people every year go through this program.

India's development faces many complex socioeconomic problems. Difficulties are compounded by national disasters, drought and the lack of education. Space systems are beginning to make critically important contributions to these and many other aspects of national life — not the least of which is the creation of new organizational and management patterns, which cut across traditional bureaucratic methods of working, and then provide to India, at least, an exciting, challenging focus for men and women from all parts of the country, wide sections of the Indian society, to work with self-confidence, to work and contribute tangibly to the nation's development.

This continuing endeavor owes a great deal to the international space cooperation and it sustains the Indian people's belief that all nations, big and small, advanced as well as less advanced, can profit from space technology. This can continue to happen only if space remains a peaceful place to work. The international space community must lend support to this mission.

In closing, I must add, to put all this into some perspective, that the adoption of a Democratic Constitution by a free India, 1948, which guarantees adult franchise to every man and woman, and upholds social justice, was perhaps a greater revolutionary step than the introduction of space technology.

Let us hope that these two elements will continue to work marching in step.

Thank you.

**MR. BARNES:** Thank you, Professor Dhawan, for that very informative and very inspiring report on how India is, in fact, harnessing space technology and bringing it literally down to earth. I think it's an example not only to other Third-World countries but to all of us.

# ASTRONAUTS MEMORIAL FOUNDATION

*Speaker:*
**Edward J. Moran**, President

**MR. MACLEOD:** Ladies and gentlemen, our next speaker is here to give you an update on a project that has gained national attention, and that is a memorial to astronauts who died in the line of duty.

Ed Moran was selected President of the Astronauts Memorial Foundation in September of '87. He serves as the Foundation's Chief Executive Officer and a member of the board and executive committee. He has an undergraduate degree from Hillsdale College, and attended the University of Michigan and Notre Dame Law School.

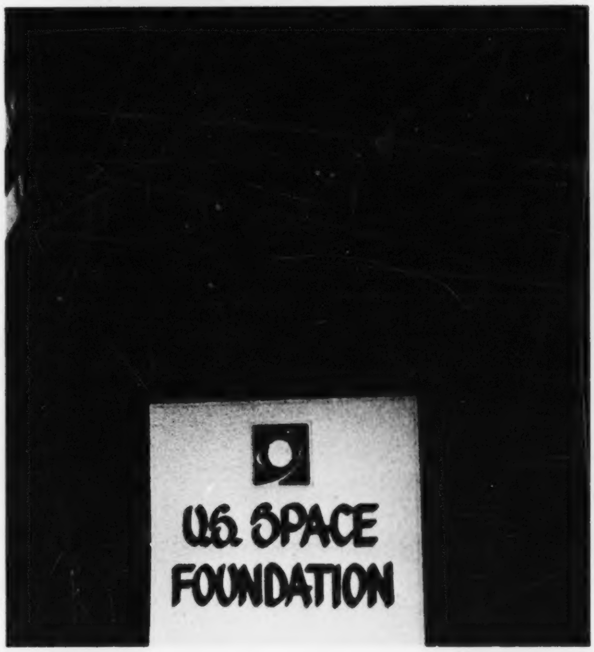
In the nonprofit sector, he served in higher education, medical and health fields. He was most recently, the Vice-President for National Development for the National Multiple Sclerosis Society. While on leave of absence as an assistant to the President of the College of the Virgin Islands, he served as Executive Assistant for the Governor of the Virgin Islands in 1969, and later as Executive Director of the territorial legislature.

He served in the Army on two separate occasions, and received a field commission during the Korean conflict, so quite a diverse background, and probably just what was needed to come in and take over such an energetic effort as you will hear described now, the Astronauts Memorial Foundation, Mr. Ed Moran.

**MR. MORAN:** Thank you, Dick. Good morning. The Astronauts Memorial Foundation was, as Dick pointed out, established as a national foundation just two years ago, for the purpose of building a memorial at the Kennedy Space Center to honor all 14 astronauts who lost their lives in the line of duty in their country's space program. Its second purpose is to develop an education program that enhances the understanding of space and space exploration.

This morning, I'm going to focus my remarks on the memorial, because on Friday, I am part of an education panel, and I will share with you then what our educational focus will be on a national basis.

The question was raised by some, "Why a memorial?" The purpose of the memorial, quite frankly, is to create a symbol, a symbol that recognizes the sacrifices of these astronauts, all 14 of them, as well as the challenges that lie before us in the space program, and as you well know, symbols are a very important part of our society. One need but recall the Vietnam Memorial, our Capitol building, the White House, the Statue of Liberty, President Kennedy's Eternal Flame, and we could go on and on, but all of these are symbols and they're very important to our way of life.



*EDWARD J. MORAN was elected President of the Astronauts Memorial Foundation (AMF) in September 1987. Mr. Moran serves as the Foundation's Chief Executive Officer and a member of its Board and Executive Committee. He received his undergraduate degree from Hillsdale College and attended the University of Michigan and Notre Dame Law School as a graduate student. Mr. Moran's experience spans twenty-five years and includes management positions in business, government and the non-profit sector. In the non-profit sector, Moran served in higher education, medical and health fields. He most recently was Vice President National Development of the National Multiple Sclerosis Society. While on leave of absence as Assistant to the President of the College of the Virgin Islands, he served as Executive Assistant to the Governor of the Virgin Islands in 1969 and later as Executive Director of the Territorial Legislature. Mr. Moran served in the Army on two separate occasions and received a field commission during the Korean conflict.*

We are told by our friends at NASA that ever since the Apollo accident 21 years ago, there have been numerous requests from the American public for just such a symbol.

Of course, we at the Astronauts Memorial Foundation are very honored to be able to respond to this demand and to serve as a catalyst and a focal point for all Americans in this great effort.

In order for the Foundation to attract the very best designers, and architects, and creative people throughout the United States, to come forth with ideas for a national memorial, we decided to conduct a national design competition. Although the Chairman of our Board of Directors is an architect by profession, we chose to retain two experts on design competitions to help us conduct the competition.

**One need but recall the Vietnam Memorial, our Capitol building, the White House, the Statue of Liberty, President Kennedy's Eternal Flame, and we could go on and on, but all of these are symbols and they're very important to our way of life.**

Dr. Lawrence Witzling and Jeff Ollswang, both from the University of Wisconsin School of Architecture, who are experts in this field, were retained by our Foundation to help carry out the program. Incidentally, I might point out that they also helped us select a jury, and that jury consisted of nationally prominent people in the field of architecture, including John Dixon, the editor of Progressive Architecture; our own Chairman, who is president of a very large architectural firm in Orlando, Florida; Ralph Johnson, Senior Vice-President of Perkins and Will, who was chosen by Fortune Magazine as one of the top architects for the 1990s; Michael Pittas, the past Director of the Design Arts Programs at the National Endowment for the Arts; and Hideo Sasaki, former Chairman of the School of Landscape Architecture at Harvard.

We had two non-voting members on the jury: Dr. Robert Brown, who's the Director of the Educational Affairs Division NASA, as well as Chuck Hollinshead, who is the Director of Public Affairs at Kennedy Space Center.

I might also add that we entered into an agreement with NASA to locate the memorial at Kennedy Space Center, and that they have been very cooperative in the efforts to help us through this entire process.

Once the program was written, we placed a rather attractive ad in the professional journals around the United States, announcing the competition. The registration was open in August of 1987 and closed October of '87.

The entry fee was $50. We were very pleased with the response. More than 1500 registrations were received from throughout the United States.

Every state in the nation was represented; New York led with 188 registrations, California was second with 181, and Florida, third with 144.

We are told by our advisors that this was the largest number of registrants since the competition for the Vietnam Memorial.

From these registrations, 756 actually submitted designs.

We learned also that the number who submitted designs was far greater than typically respond in such competitions. Normally the figure is 20 to 25 percent. More than 50 percent of those who registered submitted designs in this competition.

We're going to try to show you some of these designs this morning. The jury deliberations took place from the 7th to the 11th of this past January, and we announced the winners on January 27th from the National Press Club in Washington D.C., with a simultaneous satellite transmission to the Kennedy Space Center where we were also conducted a press conference.

We received tremendous national coverage on this memorial, as well as international coverage, and it seems to be continuing.

Before I discuss the winning design, I might tell you that the prizes included $25,000 for first prize, $15,000 for second, and $5000 for third. Awards of merit of $1,000 each were given for 5 submissions.

Honorable mentions included entries from Dallas, Texas; Cambridge, Massachusetts; Brooklyn, New York; Minneapolis, Minnesota; and Santa Ana, California.

Third place was awarded to John Blood and Craig Newick, both of New Haven, Connecticut, and second place was awarded to Donald C. Paine and Bill Gallagher of Sommerville, Massachusetts.

The first-place entry — and the one we want to share with you this morning, — was awarded to Paul Holt, Marc Hinshaw, Peter Pfau and Wes Jones from San Francisco. It turns out that these are very young individuals who have been in business about seven years, and they're only in their 30s. As a matter of fact, one of them celebrated his 30th birthday on the day we presented the winning design in Washington. They were all classmates at Berkeley, and we think they are a very dynamic firm. They have already won several national awards. We're very pleased to have them work with us.

I attended every single jury session for the entire week and watched how winners are chosen, and I can recall one of the architects saying to me, "On an average, to prepare for a submission, it takes about a hundred hours of an architect's time," and if we had over 700 submissions, and each one of them at minimum, let's say, charged $50 an hour, you can imagine what was represented in terms of time and money.

After the jury chose the winners, I asked the question, "How did the top three designs, but especially the first design, differ, if you will, from the rest of them? There must have been something that caught your eye."

Hideo Sasaki said to me, "Well, you know, it's interesting you should raise that question, because the primary difference, in the top three, between the third and the first, is that they are tied to space. They project outward; they project to the sky! Whereas the other submissions, the other entries were primarily tied to the earth, gardens, statues, waterfalls, those kinds of things."

I hadn't thought of it in those terms, but I think you will see the difference.

The winning design is dubbed "Space Mirror."

It's a 50 foot by 40 foot high mirror, finished surface of granite, which tracks the sky following the sun's movement.

The name of the 14 fallen astronauts, grouped together by the final mission in which they flew, are cut through the granite.

Behind each grouping of names are mirrors which direct sunlight through the names toward the heavens.

One of the winning architects, Wes Jones, said to me, "By floating the glowing names against this backdrop, the sky becomes the home for the memories of the astronauts, animated by the sun as it brings their names alive again. The sky becomes the field of honor across which the heroes' names are emblazoned."

**The winning design is dubbed "Space Mirror." It's a 50 foot by 40 foot high mirror, finished surface of granite, which tracks the sky following the sun's movement.**

The granite is very highly polished, and as you stand in front of the memorial, the sunlight comes from behind the memorial, and it shines into mirrors which refocus the light up through the names.

So, as you stand in front of the "Space Mirror," the granite will reflect whatever is in the sky at the moment, along with having the light come up through the names from behind the memorial.

At night, obviously, we will use artificial light.

This "Space Mirror" tracks the sun. It presents some very interesting engineering problems, because as you know, in Florida, we do have hurricanes and windstorms, a lot of salt air, and those kind of things.

The Astronauts Memorial will be located on a six-acre site, near the Visitor Center at Spaceport USA, at the Kennedy Space Center. We have budgeted approximately four million dollars for its construction, and we anticipate that the memorial will be built and dedicated within the next two to two and a half years. So hopefully in 1990 the more than two million visitors that visit the Kennedy Space Center will have an opportunity to see what promises to be one of this country's great memorials. I'm extending an invitation to everybody at this Symposium to be there when you hear about the announcement. We would be delighted to have you present. Thank you very much.

**MR. MACLEOD:** We thought that to be a report that people attending would want to hear about directly: the Astronauts Memorial at Kennedy Space Center.

As you have seen,we are working with a number of the other organizations in the space business and you will see more of that on Friday, when we have most of the principal space education organizations here participating in the Education Forum.

# PROSPECTS FOR U.S. COMMERCIAL SPACE TRANSPORTATION

*Moderator:*
**William Tutt**, Vice President, U.S. Space Foundation

*Speaker:*
**Courtney Stadd**, Director, Commercial Transportation Office, U.S. Department of Transportation

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**MR. MACLEOD:** Our next moderator is Vice-President of the United States Space Foundation. He's also the Number One man here at the Broadmoor, so all of these fine facilities that we're using, the tremendous crew that sets things up and get things down in a terrific hurry but does it without looking like it's any work at all, they work for people who work for our next moderator, Bill Tutt, a tremendous organization, a tremendous individual. Please welcome Bill Tutt.

**MR. TUTT:** Thank you, Dick. First of all, on behalf of all of us here at the Broadmoor, it's a pleasure to have you with us. We hope you have a rewarding session, and certainly a most enjoyable stay.

We do hope that you have the opportunity while you're here to explore a number of the other activities that are available to you.

It's a pleasure for me, as Vice-President of the Space Foundation, to introduce our next speaker. Courtney Stadd will be speaking to you on the prospects for U.S. Commercial Space Transportation. Mr. Stadd is currently the Director of the Commercial Transportation office at the U.S. Department of Transportation.

Courtney Stadd was appointed to that position by former Secretary Elizabeth Dole in January of 1987.

The Secretary has directed the requisite responsibilities needed to implement the Department of Transportation lead agency role for both the regulating and encouraging of American commercial space launch activities.

Mr. Stadd brought to the job nearly 15 years of experience, working with commercial space-related issues, and that experience includes with NASA, industry-funded studies. He's authored various articles on space commerce. He's participated in an entrepreneurial venture to build and fly a low-cost launch vehicle, and he's been involved either as a private sector representative or a government official in all major interagency commercial space policy reviews in this current administration.

It's appropriate to note that Mr. Stadd made his maiden speech as a newly appointed Director to his current office at last year's Space Foundation Symposium.

Ladies and gentlemen, Courtney Stadd.

**MR. STADD:** Thank you. It is indeed a pleasure to come back a year later after my maiden speech. At that time, I threatened the audience that like MacArthur, I would return, and I hoped that I would return with a progress report, and with some success stories as far as our job in getting this American launch industry off the ground is concerned.

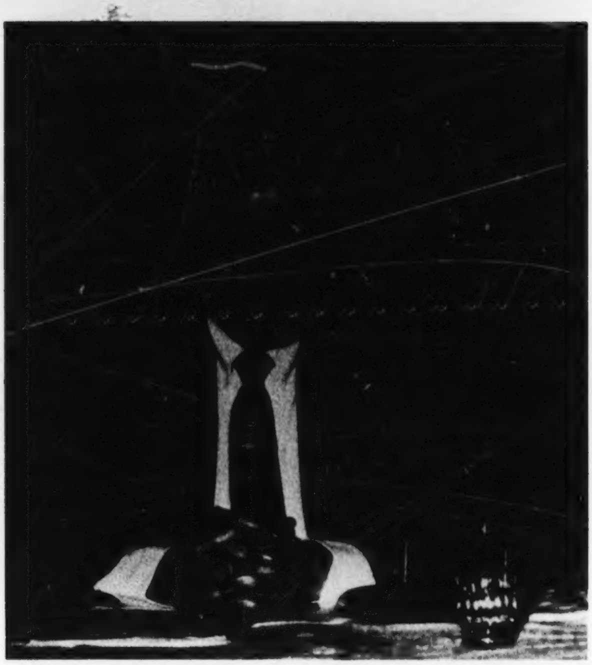
Rather than subjecting you to an extended speech, I've chosen to cobble together a few viewgraphs to help frame what I hope will be a lively discussion with you, the audience, at the end of my presentation.

Certainly, no one, as I keep reminding audiences when I talk about the subject around the country, has a monopoly on wisdom in this field. I keep saying that it's only by working together, government and industry, that we can resolve the very complex domestic and international problems associated with this policy area. In my allotted time, I will have been successful if I have managed to convey to you the policy context in which my office and this industry is emerging; give you a brief overview of the Department's responsibilities and mission in this area, as well as a brief report card on the industry; and then, make some observations on issues that are affecting the future prospects of this launch industry.

First, quickly, let's review the bidding and recall the building blocks that have been put in to place to help foster the commercial space launch industry in this country.

You all will recall the decision made some time ago to basically phase out the expendable launch vehicle, which had been the fundamental workhorse of the nation's space programs from the beginnings of the space program as we know it.

But in the early '80s, there were those, both in gov-



*COURTNEY STADD oversees his Department's activities as lead Federal Agency in cutting the red tape to allow the development of a commercial space launch industry in the United States. Mr. Stadd earlier was in the Department of Commerce's Office of the General Counsel, advising on commercial space policy issues. He has been active in a variety of national space policy forums, in particular the Economic Policy Council's Commercial Space Working Group. Stadd had previously been the Director of the Washington office of Starstruck, Inc., a California based spacecraft manufacturer. He has also been active in a variety of non-profit educational and scientific organizations, including the National Space Institute and Georgetown University's Institute for the Study of Space. Stadd holds a Bachelor of Science degree in International Economics from Georgetown University.*

ernment and in industry, who argued that we ought to retain that capability in some form. Secretary of the Air Force Aldridge, and the Department of Transportation, were quite active in arguing that the nation retain and expand its commercial launch capability.

Out of that discussion and debate came two fundamental building blocks. One was the executive order issued by the President in February of '84 that defined the Department of Transportation as the lead agency for this industry, followed seven months later by the Commercial Space Launch Act, which Congress passed and which gave us very broad responsibilities in terms of regulating this industry.

In fact, I will argue later on that I think that piece of legislation was as landmark, in some ways, as the Kelly Mail Act of the 1920s, which formed the basis, many would argue, for the civil aviation industry.

Of course, the Challenger accident essentially galvanized efforts to reconsider a mixed fleet approach. Ultimately, that principle was articulated in the National Space Launch Strategy, and, then, reaffirmed in the recently announced National Space Policy. One of the fundamental contributions of that policy is the recognition of a separate and distinct commercial sector.

Let me just walk you briefly into that policy and cull from it those three items that are of particular concern to us.

First, of course, is the continuing prohibition against the government competing with the private sector. If there was one consistent theme surrounding the industry's interest in getting back into the expendable launch vehicle business, it was that they had enough burdens without having to compete against the United States Government. The President made that prohibition a reality a year ago, when he basically precluded the shuttle from launching commercial satellites.

Secondly, the space policy defines commercial space transportation as an integral element of the nation's transportation capability. And throughout the document, there are phrases to the effect that the government buys commercial services whenever feasible.

From all this comes some bureaucratic relandscaping. In the case of this Department, the policy reaffirms and strengthens our overall responsibilities.

Let me just identify what the commercial space project empowers us to do. We license all American space launch activities, be they conducted from federal ranges, be they conducted from private sites, be they conducted from foreign sites, if the firm is a majority owned American company.

We are responsible for certifying commercial spaceports as safe, and we are responsible for conducting what we call mission reviews for all payloads with the exception of domestic communications satellites, which are licensed by the FCC, or in the case of remote sensing satellites, by the Department of Commerce.

Therefore, because the bulk of the contracts signed with U.S. launch firms, as I will get to later, are with foreign customers, we are responsible for reviewing, from the public safety and liability standpoints, all of those various satellites. In fact, we've completed several of their mission reviews to date. Of course, under the National Space Policy, NASA and the DOD retained their historic responsibilities. In NASA's case this means a continuing lead role for government civil space R&D across-the-board; continuing to manage the shuttle operations, and through their office of commercial space programs, encouraging new commercial applications. DOD, of course, is responsible for military space transportation. The Air Force is essentially the landlord at the ranges.

Just to reemphasize, our role is to encourage a competitive and diverse launch industry, with the emphasis on regulating efficiently to encourage safe and responsible launch activities.

Let me remind you of an anecdote which, I think best captures one of the primary reasons for setting my office up. Back in 1982, Space Services, Inc. (its current President is former astronaut Deke Slayton) sought a license from the government to launch from Texas. It took them six months, involving over a dozen agencies. All this to launch a test payload of 40 gallons of water. Our role at the DOT is to consolidate those various authorities, so that you have essentially one port of call.

**Our role is to encourage a competitive and diverse launch industry, with the emphasis on regulating efficiently to encourage safe and responsible launch activities.**

The bread and butter of a regulatory agency is basically doing safety research and analysis. Please forgive this oversimplified analogy, but it's one that I think captures most effectively the value that the Department brings to this new industry.

The way we've approached space transportation these past decades is, and as I say, this is an oversimplification, but essentially, it's been comparable to building the car on the highway each time one seeks to go into space.

That is not what I call very efficient; it's not what I call very cost effective. The only way that a commercial space industry can thrive is to thrive in an environment in which small rockets and big rockets can occupy basically the same highway, if you will. But to allow that, you need a common set of requirements, standards and so forth, that allow these companies to operate in a safe manner, as far as the public is concerned, and that's our bread and butter.

We, essentially, are concerned with understanding the histories of the various vehicles, and establishing a baseline that forms a basis for these standards and requirements. So we are, right now, working very closely with NASA/Air Force, tapping into their archives of safety data. What you find, by the way, is that there's a great deal of data that pertains to specific vehicles being launched under specific circumstances. Our job is to coalesce that information, again, into a common baseline, that allows the Deltas and Titans, and so forth, to launch from a common environment.

The Congress has given us the mandate to establish insurance requirements. To do that again, we have to perform risk assessments. We currently have, in peer review, a comprehensive public risk analysis regarding commercial launch activities. This really is the first time that government has looked at all classes of vehicles, involving roughly 10,000 launch activities, and systematically assessed the public hazards associated with this mode of transportation.

Of course, we're involved in establishing requirements for licensing and in the area of environmental impacts, we are given very effective authority to issue environmental assessments. I recently approved one for Vandenberg, and by the Defense Department's own admission, if they had done it on their own authority, it would have taken two years; it took us about seven and a half months working with DOD to issue that environmental assessment.

This chart is basically a quick snapshot, of where we stand with our constituency in this country. We start at the left end with Martin Marietta.

Then the Delta and General Dynamics with the Centaur, and finally, three entrepreneurial companies. We announced a month ago our very first launch license to Conatec. They're planning their first launch at White Sands Range in New Mexico in October.

To show you how difficult it is to predict where this industry is going, if I had told somebody a year ago that a sounding rocket would be our first license, people would have been somewhat skeptical. Secondly, if I said that they would be launching a materials science experiment, and that it was European, they would have thought that would be stretching it. But that's precisely what Conciter is hoping to be carrying on its launch.

We also have the ILV, which is the launch vehicle under development by an entrepreneurial firm Rocket Company, and of course, Conastoga, which is under development by Space Services. I don't mean to do an injustice to some of the other entrepreneurial firms, Pacific America, and Third Millenium, that are also seeking to develop their own systems.

In the foreign arena, we have the Protons and the French Ariane system. The Japanese continue to insist that they're not interested in the commercial market, but if you believe that, I have some oceanfront property in Kansas City. They are looking to launch their H-2 in 1992. I foresee that they will be an active player in the commercial market.

The last two vehicles are two variants of the Long march that are being marketed by the Chinese.

I promised a report card. As I mentioned, we licensed our first commercial launch. We just received the second application, several weeks ago, from McDonnell Douglas for a launch in early '89. There are approximately 13 contracts, something in the order of 700 million dollars, signed, with, American launch firms, and roughly 17 reservations being negotiated in the market with American firms.

Approximately 400 million dollars have been invested by the commercial companies is a somewhat soft number. You could argue that, in fact, somewhat more has been invested by the larger companies.

The 8,000 jobs generated by this industry is anecdotal information provided by the industry — that's more or less what they see in terms of direct and indirect jobs in the next few years. There's about a billion dollar market being addressed by the American launch industry today; the bulk of that, of course, represents the shuttle off-loads.

I do note that each time a foreign payload is launched, we've got a trade offset ranging from $40 to $100 million, which is the Delta vehicle to the loaded Titan.

In terms of our own licensing activity we granted that one license. We have one pending for McDonnell Douglas. We have completed two mission reviews, involving INTELSATS, for Martin Marietta. We have one in process for Martin Marietta right now and we expect at a minimum, five full applications by summer of '88. In this week's "Aviation Week" is a pretty good breakdown of our expected licensing activities at the end of the year, and I expect as many as ten applications by the end of the year.

Many of you are aware that at least two states, Hawaii and Florida, have, within the past two months, endorsed the establishment of private launch sites. I had the privilege of representing the Secretary of News Conferences, convened by the Florida Governor Bob Martinez, in which he endorsed a $500,000 feasibility study to look at establishing a space port. His people are insistent that it's not an "if" study, rather a "how-do-we-do-it" study effort.

I didn't put any numbers on these slopes regarding future space market, because I think that's what a lot of these graphs are worth, which is not very much. If you're like me, you have seen a lot of these graphs projecting where the various space applications will take us. This at least, gives you some of the basic categories, remote sensing, MPS, materials processing, and of course, communications satellites which comprised anticipated markets. It is very difficult to accurately characterize where this industry is going, especially after the bulk of the shuttle offloads is worked through by 1991 and '92.

Having said that, I do think that people who tend to be highly skeptical, are people who tend to take a snapshot of the American industry as it exists today, and then project it in linear fashion out over five more years. I think this is fundamentally flawed because you're already seeing some interesting dynamics at work here in the industry. To wit, a month or so ago, General Electric announced a turnkey arrangement with Martin Marietta, which involved a commitment of 15 satellites to fly on the Titan system with a rather substantial penalty clause if they choose to go elsewhere. Of course, they have a right to, but there is a built-in incentive to work with American launch firms. I'm aware of at least one other similar arrangement that is being developed in this country.

If I have any theology that I believe in in this area, it is called demand creation. It is my view that now that we have, to some extent, removed government as the marketer, and are encouraging the customer to work directly with the launch supplier. All sorts of marketing opportunities are possible. I think you're going to see all sorts of innovative applications.

For example, General Electric is currently marketing the space recovery vehicle. That vehicle can be fitted on all expendable launch vehicles. It has flown for many years for the U.S. Government and was recently declassified. Once it's inserted in orbit by the expendable launch vehicle, that system would be able to service a payload, free flyer, or whatever, and then under its own power, return by chutes back to earth. That's a new dimension to these old workhorses that one might not have considered just a few years ago. Who knows what other innovative adaptations are possible for tomorrow's ELV's?

**I think there's some advantages to taking these private space ports seriously.**

And I think there's some advantages to taking these private space ports seriously. As an example of how much skepticism you should retain when people talk about market projections, I'm reminded of how certain many people were in the communications satellite industry, that there would be a market niche in the late '70s, early '80s, for high volume data traffic between large corporate actors, basically, real time data transmission. That market has yet to develop. Instead, the corporations have retained an interest in voice transmitters, and that's had an effect on the marketplace, that would not have been anticipated just a few years ago.

Some people say it will be a fiber era, and we'll see COMSATs will be a very insignificant part of the market, if you look at out over the next decade or so. But, then again, High Definition TV may represent a new market opportunity. Certainly the Japanese, who are intending to establish their own system in the early '90s, are taking that application very seriously. Geostar Corporation, plus two or three others, are progressively marketing radio determination satellite-based systems. Of course, we also have the mobile satellite systems which are being aggressively marketed. That's just in the COMSAT area. One is hopeful that remote sensing, and, of course, MPS, over the next decade or so, may represent additional markets for our industry.

I was quoted in one of the trade magazines recently, accurately, as saying that anybody who talks glibly to you and has all sorts of quick answers about this industry, they've got a piece of wisdom that I wish I had access to.

It's been a tough year for us in the Administration, and it's only really through the services of some very dedicated people at NASA headquarters and the Air Force, that we've gotten the progress that we've had, and I think it's not insignificant.

Certainly, the joint use of government facilities remains as significant an issue today as it was when I first brought it up a year ago on this very stage.

It's a fairly awkward fit for the government to have to share its facilities with commercial operators. It's an awkward fit from the standpoint of who gets priority.

**Anybody who talks glibly to you and has all sorts of quick answers about this industry, they've got a piece of wisdom that I wish I had access to.**

On the other hand, the commercial customer wants to be sure that they are given priority, because they want to get up and work and start generating revenue. We're still working that out, and I think many of the issues that looked like they were showstoppers just a few months ago are being, I think, rather effectively managed.

Another issue involves allowing commercial launch firms to share processing facilities and payload integration facilities at the Cape.

Clearly, the emphasis of the Administration's policy is to encourage the companies to go outside the government fence, as it were, and seek commercially operated payload integration facilities. For example, what do you do, if there isn't any capacity available on the other side of the fence? I've got some answers to that, working with NASA/Air Force on those questions, but those are examples of some of the day-to-day dispute resolution issues that all three agencies are confronted with.

Allocation of risk principles, that's been a real tough one. Congress, as I said, gave us the mandate to establish assurance levels, both regarding the property, as well as third party. We had a bruising set of fights within the Administration on this one.

I think we've come out of it with an achievement. I think that the Administration's proposal, which is to have DOT establish a level of assurance, up to a point that we feel is adequate. It represents the maximum probable loss scenario beyond which the government will waive recovery of damages. We also have a negligence standard, which, I think, is an effective mechanism.

The third party liability area still is an issue, but the Administration has enunciated a principle, whereby we are willing to cap so-called pain and suffering. As far as the direct economic damages are concerned, there is no cap, but nonetheless, we are, at the Department, through our various analyses, I think, coming up with some approaches that I think the industry is finding very helpful in that area.

International competition is a tough one. The President asked the United States Trade Representative to take the lead in exploring with the Europeans whether we could establish rules of the road, or some form of foreign trade practice rules, if you will, in the international launch service market to allow our industry an equal opportunity. We're still in the exploratory phase, but clearly, there's a great deal of concern amongst our industry about having market-driven actors compete against, at least in some cases, state-supported industries.

Clearly, there are still issues regarding technology transfer; for example, there are a number of industries in this country that would like to joint venture with some companies abroad. Of course, in the rocket field, this type of arrangement always represents sticky issues, as far as technology transfer is concerned. And there is this old question that continues to plague the Administration, which is what is the appropriate federal role in research and development technology? There's been a lot of papers, a lot of talk, a lot of conferences on that particular issue. Our industry advisory committee has recommended to the Secretary that he support having the government develop what they call component technologies. In that, government would no longer have the prime responsibility for "specing" out the entire launch system and then turning it over to the industry. Instead, the government would take the lead in pushing the envelope, if you will, in spacecraft-related technologies, and then have those to be incorporated by industry as they see fit.

I think that we're also going to have to look to the industry to come up with some greater reinvestment strategies. The government has to bear its role in R&D, but also the aerospace industry has to begin to look at this new business in different ways. Last year around this time, it was announced that the Air Force had issued a contract to McDonnell Douglas to build the Delta 2. One of the criteria in the procurement was that it be commercially viable. Clearly, that contract has provided a crucial production base which has certainly been a very key element in their ability to be a viable market player.

Several major aerospace actors are competing for the MCV 2. Clearly, the winner of that will affect the dynamics of the industry.

And now to the summary.

I think we've got in place an affirmative policy environment, but that's only half the equation. The other half is making it work. For 30 years, the Government has been both the launch operator and range operator. Now we're being asked to divorce ourselves from the launch operation role. That arm's length relationship to this transportation field is new for all of us, and it's requiring everybody in traditional agencies that have dealt with this area, let alone DOT, to develop a new mindset, as it were, as we deal with these new issues.

**I think we've got in place an affirmative policy environment, but that's only half the equation. The other half is making it work.**

At DOT we are aggressively building our internal capability, and assuming that Congress gives us the funding, which we desperately require this fiscal year, to meet the increasing licensing traffic. I'm optimistic we will continue to be successful in meeting our mandates.

I've shown you that the industry, at least to date, has stepped up to the challenge of establishing America's competitive position in commercial launch service. It is a credit to the boards of directors of these companies that have done so. I'm also pleased that the smaller entrepreneurial companies are continuing to push their business plans. Traditionally entrepreneurs are agents of change.

In terms of the prospects for the the commercial space transportation field, let me end on what may appear to be a truism. But it is one that one would ignore at one's peril, which is, that in order for this field to continue to move in the right direction, after people such as myself leave this Administration, and the new Administration come in, we have to continue to foster strong government- industry cooperation in order to maintain a strong technology base.

That ends the presentation. I look forward to your questions. Thank you very much.

**MR. TUTT:** Thank you, Courtney. The first question is what is the status of the bill before Congress that would affect liability considerations of private launches?

**MR. STADD:** What is the status? From a congressional standpoint, I understand that they will be introducing that bill formally within the next week or so. Credit is due the Subcommittee on Space Science and Applications, for making due effort to hear all of our concerns. I think that it's a better bill for that. But as I have testified before that same committee in the last couple of months, the Administration has a different point of view in terms of a third-party solution.

The Congress, in this case, is proposing to indemnify, another way of saying subsidize, provide funding for the industry to address damages, beyond a level of insurance, that we set, and that the industry pays for. This Administration, as well as past Republican/ Democratic administrations, and the Congress have traditionally been opposed to indemnification. I have argued both sides of this issue, but it is the position of the Administration that indemnification is not the preferred approach. As we've seen with general aviation and some other critical sectors in this country, both the Administration and Congress have historically not supported using indemnification to resolve excess liability concerns.

**MR. TUTT:** Next is a two-prong question. Should the U.S. Government subsidize our private launch sector, and can we compete with foreign launches if we do not have such subsidies?

**MR. STADD:** I had the privilege of briefly working with the late Secretary Baldridge who liked to remind businessmen that one man's subsidy is another man's market incentive.

This Administration is on record that it is not supporting direct subsidies. We have a direct-cost approach to pricing and costing our facilities for use by the industry. On the other hand, the industry, by and large, is using American taxpayer paid-for technology.

We are transferring that technology to the private sector. There's some bumps in the road in that transition, but we're doing it, and we're transferring title to that technology to the industry. And in the regulatory area, as I mentioned, we are putting our resources to bear to make that arena as minimally difficult as possible. But you asked about how do you compete against non-market actors. It's tough.

One of the great advantages of our industry is that Americans, by and large, invented this technology after the World War; obviously, some Germans went to another country, but we have got some pretty good talent too, as we all know. Other countries have clearly benefited from our technological advances in the rocket field. We also have a very competitive reliability record. Our industry enjoys an average reliability record of ninety-two percent plus. That's based on hundreds and hundreds of launches. The nation states against which we're competing have maybe a score of launches, and all are running by reliability far below ours. That is basically what is attracting customers to fly on our systems. If you're a satellite operator you're not in the business to collect insurance, you're in the business to collect revenue. But in terms of the long term, competing against the system is tough and that is why we're interested in exploring trade talks on launch services with the Europeans.

The Soviets have been aggressively marketing. They've been trying, without success to- date, to procure Western satellites. Our department joins with the State Department in prohibiting American systems from launching on Soviet launch vehicles.

Without naming the particular competition — most recently, there was one where it was a heated battle involving Ariane, our country, the Soviets, and literally within a span of 48 hours, the Soviets ranged from a price of 40 million to zero. I gather that at this conference there is an individual marketing for the Soviets. I'm sure he's got a persuasive rationalization for being a marketer for the Soviets. But the rationalizations I've heard to date don't satisfy me. The question addresses a tough challenge for us, and it's one that's going to clearly spill over into the next Administration.

**MR. TUTT:** Following up on the question of subsidies, subsidizing our private launch sector, what is the Government's policy on charging the private sector for services and information provided by the government, and has the government considered royalties on profit participation as opposed to a one-time flat fee?

**MR. STADD:** I'm going to answer part of that, because that gets into an area that I'm not expert at.

Let me address that which I know something about, which is the bread and butter of the Department of Transportation — user fees.

Every year, my office has to tell the Inspector General why we don't charge users fees. In fact, just before I left Washington to come here, I had to deal with that issue yet again.

It is my view that industry has enough problems without having us impose the costs of our learning curve. However, as the industry matures, clearly you can make an equity argument for some form of user charge, if only to cover the administrative costs.

In order to do a recently completed environmental study, it costs us a hundred thousand bucks. In order to do that license for Conatec it cost us about a couple hundred thousand dollars. I, as any of my staff can tell you, tend to be a Scrooge with the pennies Congress gives us. But I can defend every penny. I think when we issue soon, in the next couple of weeks, our insurance determinations for Conatec, it will be the first time the government has issued an insurance determination for a commercial launch applicant. We'll be issuing numbers for both the property and third party.

I hope that you will all see where that money went, because I think the analysis that went into that set of numbers, is hopefully useful to the industry.

**MR. TUTT:** We have more questions than we have time for, so I'll just take a couple more. One, does DOT foresee environmental certification problems related to the use of propellants, solid and liquid storables, and cryogenic used by existing vehicles, Titan, Atlas, Delta?

**MR. STADD:** You always hear about the problems. You don't hear about those that are fixed. A year ago, we issued a programmatic, generic environmental assessment. Translated, that means we just basically issued a document that covers today's existing launch technology. We found it to be essentially — I'm not going to use the word benign — but we were able to satisfy the Environmental Protection Agency's concerns in this area.

In the past, when one of the established aerospace companies entered the State of Florida to launch from the Cape, they did as an agent of the government. But today, when they enter the State of Florida as a commercial entity, suddenly the state environmental office for example is interested in that entity. We're hoping through our environmental assessments that we've begun to date, that we have addressed the EPC concerns. We're uniquely qualified to do this because we speak their language.

**MR. TUTT:** Final question, would you expand on your comments regarding international competition. Assuming satisfactory agreement between the U.S. and Europe on the "rules of the road," do you foresee an extension to the Soviet Union and the PRC?

**MR. STADD:** Let me say that I certainly do envision, maybe not on my watch, that the frame of reference that the two leading actors in this market ultimately achieve, ESA, the European Space Agency, and the United States Government, will ultimately have to encompass other launch entities - Japanese, Chinese and so forth. The President of Arianespace has been a great advocate of these talks, and I think he's absolutely correct that unless we and the Europeans can work out some semblance of an agreement, we're in for a lot of trouble in making a case regarding unfair practices when those other foreign entities come out full board market in the '90s.

As far as the Soviets are concerned, it seems to me that Gorbachev has discovered a lot of things. Nonetheless, I don't think that on his nightstand is Adam Smith, so I'm not optimistic that we'll see the Soviets included in such an agreement in the forseeable future.

**MR. TUTT:** With that we'll close this morning's session. Thank you, Courtney, for an excellent presentation.

# LUNCHEON

***Planning for the International Space Year***

*Moderator:*
Astronaut **Gene Cernan,** Director,
Marketing and Development, Aerospace/
Government, Digital Equipment Corporation

Speaker:
**Dr. John L. McLucas,** Chairman of the Board,
Questech, Inc.; Chairman, NASA Advisory
Council

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**MR. MACLEOD:** Assisting us today, sponsoring this luncheon is a new firm in Colorado Springs: Starfind. We're delighted to have them here. You will see some materials on the table and elsewhere that will tell you something about what the company does.

And, at this time, I would like to acknowledge and introduce Richard Halavais from Starfind.

As all of you know, we're a nonprofit corporation. The only way you can put on something like this Symposium is with the help of sponsors. We will work hard with you to do the best we can in producing programs the way we need them, if, as the speakers have been saying the last day and a half here, we are going to make progress in space.

As we begin our program for the luncheon, I want to introduce the moderator, because he's an exceptional individual. Assisting us this noontime and introducing and moderating the speaker is Astronaut Gene Cernan. Gene is the Director of Marketing and Development for Digital Equipment Corporation. Most of us know him as Capt. Gene Cernan, a U.S. Navy astronaut, who was the last human to leave a footprint on the moon. We have here today, of course, Buzz Aldrin, who with Neil Armstrong made the first moon landing, and Gene Cernan the last one as the leader. Ox van Hoften represented the latest period, if you will, of shuttle flights, and Deke Slayton is from the original seven.

As you know, Gene has had a long career. He was the senior negotiator with the Soviets on the Apollo-Soyuz mission. He has worked on testing and development of a number of different space systems and portions of space systems. He's been active in professional societies across the country. He's probably best known right now in Middle America, if you will, as a technical commentator on space for ABC-TV. And when you see Gene Cernan on "Good Morning America," the next time, remember you saw him live on this podium. Come on up, Gene, and do your thing.

*CAPTAIN EUGENE A. CERNAN, USN (Ret.), before joining Digital, was Chairman of the Board and President of the Cernan Group, Inc., and The Cernan Corporation, space-related technology and marketing consulting firms. He also acts as a Technical Consultant with ABC Television in support of ABC News and Special Events programming. After serving twenty years as a Naval Aviator, Capt. Cernan retired from the U.S. Navy in 1976. Thirteen of these years were dedicated to direct involvement with NASA as an Astronaut. Capt. Cernan carried out three separate space flights: as the pilot on Gemini IX, he was the second man to walk in space; with Apollo X, he ventured to the moon; and as Commander of Apollo XVII, holds the distinction of being the last man to leave his footprints on the surface of the moon. From 1973 to 1975, Capt. Cernan served as a Senior U.S. Negotiator during discussions with the USSR concerning the joint U.S./Soviet Apollo/Soyuz project. He received his B.S. in Electrical Engineering from Purdue University, and his M.S. in Aeronautical Engineering from The U.S. Naval Post Graduate School, with additional education at the Wharton School of Finance and Northwestern University. Captain Cernan was awarded Honorary Engineering Doctorates from Purdue and Drexel Universities, and an Honorary Doctorate from Western State College of Law.*

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**CAPT. CERNAN:** Thank you, Dick; you forgot the most important thing, I'm a member of the U.S. Space Foundation, right?

**MR. MACLEOD:** Right on.

**CAPT. CERNAN:** The definition of the moderator is one who gets a chance to be introduced and have all the accolades thrown at him like Dick just did, and who then passes the buck to somebody else who has to do the work. So that's what I'm going to do here today.

I have a couple of comments I would like to make. One is I would also like to thank Starfind and Dick for hosting this lunch. As you know hosting a lunch can be done by almost anybody at any time, but the unique thing about the host of this lunch is that Starfind is one of those young, entrepreneurial, commercially oriented, private companies that we've been talking about, that we've been trying to put an environment together for, which people like Dick and his organization can exploit. I think it's significant that you're in a position to host a luncheon like this so early in your career of planning, but thank you very much.

I would also like to congratulate Gen. Jim Hill and Dick, because from what I have seen yesterday and today, this is the start of another super Symposium. If the presentations yesterday, and this morning are any indication of what's to come, then I think the Symposium is going to be a rousing success.

As you all heard yesterday, though, the thing we're doing here, unfortunately, is singing to the choir. I believe, as Brenda said very aptly, we've got to get out and pound the sidewalks and the streets and the bushes, and get that constituency, by national poll some 80 percent of the American public. We've got to get them vocal and we've got to get them behind what we are talking about this week at this Symposium. But also, I want to remind you what I don't want: I don't think this Symposium should be treated like Easter Sunday, that is, you go to church, and then you forget about it the rest of the year.

This organization, and this Foundation operates every day of the year. There is something happening, there are plans going on, and I think I can speak very loudly for Gen. Hill and Dick MacLeod. We need your support, and any other support you can bring to the table, 365 days a year, so that we can accomplish the things we're talking about and not just come back next year and talk about them again.

**I don't think this Symposium should be treated like Easter Sunday, that is, you go to church, and then you forget about it the rest of the year.**

Just one year ago, I had the opportunity of giving a short presentation across the hall. The theme of the conference was built around vision. And I said something at that conference — maybe some of you might remember — that the flags of our nation which fly today at such historical and yet almost forgotten places like Tranquillity Base and Valley Taurus Littrow, were not simply the result of a dream or a vision, they were a result of action. They were a result of the effort and the dedication and the self-sacrifice of millions of Americans. And those flags which fly today on the surface of the moon, eons of miles away, effectively are the result of the commitment of a nation. A commitment that was made when we barely had 15 minutes in space. That commitment was made when Al Shepard's feet were still wet with salt water as they pulled him out of the Atlantic, and that commitment was stated clearly in President Kennedy's message to the world, not to the nation, but to the world, over 25 years ago, when he said, "We will go to the moon and do the other things, not because they're easy, but because they are hard."

But I believe lost in that message, and lost in that speech that he gave to this nation, were some other words that I uncovered recently. The words, I think, were probably soon forgotten after he made that speech, but I think they're very apropos, today in 1988. I want to quote those words for you, because in addition to any part of that commitment, President Kennedy said, "This country does not intend to flounder in the backwoods of the coming age of space. We mean to be a part of it. We mean to lead it."

I want to say that again.

"This country does not intend to flounder in the backwoods of the coming age of space. We mean to be a part of it. We mean to lead it."

When those words were spoken by President Kennedy over 25 years ago, I'm sure they were intended to be the foundation of this nation's growing space program, and certainly, they were a commitment toward where this country was headed in the future.

**"This country does not intend to flounder in the backwoods of the coming age of space. We mean to be a part of it. We mean to lead it."**

Today, unfortunately, those words no longer represent a commitment, and no longer represent a foundation, but they do represent something equally important. They represent a challenge, perhaps the biggest challenge this country has faced in a generation. Perhaps, even more so than the challenge which Neil and Buzz faced when they first walked on the surface of the moon back in 1969, those words, Dick, might well be the bywords of this Symposium in 1988, because your theme is Space Challenge '88, and I know of no other challenge which is more appropriate than that challenge which was spoken of by President Kennedy a quarter century ago. It's a challenge that I believe, if ignored, will inevitably and certainly change the future history of this nation of ours.

Our speaker this afternoon is going to address that future, and I hope he addresses how we can make the

American public more aware of the challenge that this nation faces today. He's certainly qualified to do so. He has held several distinguished, prestigious, and certainly responsible positions in government and in industry.

He is among the few. He has been Administrator of the FAA. He was Secretary of the Air Force. He's a member of the National Academy of Sciences. He's served NATO and the DOD. He's been an executive at COMSAT. He's been President and CEO of the Mitre Corporation, and President of HRB-Singer Corporation.

John, if I may ask, could you not hold a job?

He is presently Chairman of NASA'S Advisory Council, and he's Chairman of Questech Inc., but he's here today to talk to us about the year 1992. He's here today, as a Chairman of the United States International Space Year, to tell us what we can look forward to, what it's going to take to get us there, and hopefully, what's going to happen in 1992, and beyond.

No more qualified person than John McLucas, who will discuss that subject with us. John, please.

*DR. JOHN L. MCLUCAS is currently President and Chairman of the Board of QuesTech, Inc. He worked in various executive position at COMSAT from 1977-85 including President of COMSAT General. Dr. McLucas was; the Administrator of the Federal Aviation Administration from 1975-77, the Secretary of the Air Force from 1973-75, and Deputy Director of Research and Engineering for the Department of Defense from 1962-64. Dr. McLucas received a B.S. in Physics from Davidson College, a M.S. in Physics/Math from Tulane University and a Ph.D. in Physics/Electrical Engineering from Penn State University.*

**DR. MC LUCAS:** Gene, there may be something to your comment about not being able to hold a job, but I refuse to face it. Gene gave me a very gracious introduction, including some things that I have not done, and I'm reminded of Mark Twain who said, "The announcements of my death are totally premature," or words, to that effect. The announcement that I chaired the NASA Advisory Council is premature. I think Dan Fink would claim that he's still the Chairman of the NASA Advisory Council, and I see some members of the council here, who say, does McLucas think he's already succeeded to the throne?

Anyway, I have been told that that would happen on July first.

I'm glad to be here with you to talk about the International Space Year. The International Space Year is not very far away, so it's time that we begin to focus on what we should do to get ready for it.

On my calendar, it's four years away, and there are some important things that ought to be done because I think the International Space Year presents us with a special opportunity.

What is the International Space Year? One way to answer the question would to be say that it's the sequel to the International Geophysical Year, and some of the younger people in the room, might say well what was IGY? IGY took place back in the '50s, when a number of people decided that we had the technology, which we could use to learn a lot more about the earth than we actually knew then, and if we applied ourselves in a concerted way and on an international basis, we could indeed improve our knowledge of the earth, by maybe an order of magnitude.

So, IGY then took place in 1957/58 — it actually lasted about a year and a half — and it really did give us a quantum increase in our knowledge of the earth.

Many things were planned to be done at that time, and most of them were done. The one that was planned, and which had more impact than probably anything else was that both the United States and the Soviet Union planned to put an artificial satellite in orbit; first to put up a simple satellite, to demonstrate that it could be done, and then to go on and use more sophisticated satellites to gather data about the earth and about space itself.

### What is the International Space Year?...it's the sequel to the International Geophysical Year

Most of you know how that particular series of events came out, in something called Sputnik that went up in October of 1957, and a lot of people were shaken up because they just assumed that since we were also trying to get ready to put up satellites, that the U.S. satellite would go up first. Well, there were many good and bad things that were associated with the fact that the Soviet satellite went up first.

Since we can't change history, I think it's best that we concentrate on the things that we did, which were all to the good.

In other words, having seen that we were not all that great in terms of being able to put a program together and get it off the ground before the only other space power could do it, we then started to take certain actions to improve our position, and I think that was all to the good.

The IGY was a way of learning about the earth and using space to get a head start on some of the problems that we wanted to deal with. Thousands of people were involved in that, yet by today's number of scientists, engineers, entrepreneurs, industrialists that are involved in space activities, the activities that went on in the IGY back in 1957/58 were peanuts.

We have an order of magnitude more people who are trained, qualified, able and interested in operating in space. Therefore, it behooves us to put together a program which would be a worthy successor to the IGY program of 1957/58.

The year 1992 has been designated as the International Space Year.

That's 35 years after 1957, in case you haven't added it up.

What's magic about 35 years? Nothing. It just happens to coincide with our five hundredth anniversary, and therefore, is a magic date to plan an International Space Year.

This whole thing began when Senator Spark Matsunaga of Hawaii decided to make something out of it. He proposed a resolution to be passed by Congress to declare 1992 as the ISY.

He was able to get that through the House and Senate. That was in 1985, and in early '86, the President signed off, so it became official policy. At the same time, NASA got on board, and so we were prepared to do something about the ISY.

Within a few months thereafter, a number of things were starting to come together.

**It just happens to coincide with our five hundredth anniversary, and therefore, is a magic date to plan an International Space Year.**

In July, COSPAR, the Committee on Space Research, set up an ISY planning committee. COSPAR is an informal, but very powerful and effective committee of scientists. It includes space scientists from all the countries that have any significant effort in space.

Two months later, COSPAR'S parent body which is called ICSU, the International Council of Scientific Unions, an even larger group of people, set up its own ISY planning committee, so here we had two of the principal scientific space-oriented organizations in the world making something out of the ISY, and both of those groups asked their members to submit proposals which could be adopted by the committees at large.

This was happening in the summer of '86, and in the fall of '86, the IAF, International Astronautical Federation, had their regular annual meeting, and they set up a committee called the IAF/ISY committee.

Three months later, the National Academy of Sciences in the United States, and the Intercosmos Council of the Soviet Academy of Sciences, got together to set up ISY committees of their own, and to exchange ideas on what should be done as a result of having established those committees. So, in roughly one year's time after the initiative that was taken by Senator Matsunaga, we had a significant number of activities underway to explore this good idea of his. Also we had people engaged in planning and in drawing up an appropriate agenda of things that could take place during ISY.

I was introduced as being head of U.S.-ISY, and so I should say a word about that.

U.S.-ISY was an association which Spark Matsunaga also asked to have set up. The first thing I talked about was the designation of 1992 as ISY. You might call it an official happening, because it's a resolution of the Congress, signed by the President. The creation of the U.S.-ISY Association is what I call an unofficial event, where Spark asked for a number of us, half a dozen or so, to get together to form this nonprofit organization for the purpose of propagating information and ideas about the ISY, and we were very happy to do that.

The reason I go into the informality of this, as opposed to the official designation of ISY as a year, is to point up the fact that we don't claim any special prerogatives about the ISY. The ISY Association, which I head, is a group which tries to promote the ideas of the ISY, but we don't claim to originate all those ideas. We don't claim to have any corner on the market. What we would like to do is when we hear something good that's going on someplace, to propagate information about that idea to other people. And to that end, we have started something called the ISY News which is published periodically. The purpose of this is just to get the word out, and if we have any good ideas to put in here, we will do so. In particular, we're going to rephrase, rehash, rebroadcast information about things that were already going on before we got onto it.

In our first issue, we have comments from Jim Fletcher and other people about getting on with ISY.

In addition to our publications, we will hold conferences from time to time. We've had one such conference. We held it in Hawaii, last August, and the first conference that we held is similar to the one we are about to hold in two weeks. It's based on an invited set of people whose backgrounds and positions are such that they can contribute to generating ideas, and making things happen with respect to ISY. I don't want to say that we have yet run a conference as large as the one here, where lots of people are invited. So far, we've had one conference; we invited 150 people from about 12 different countries and organizations. We had a good turnout. We received lots of good ideas. We prepared a report, and I think it was a useful service.

I'll mention a couple of the ideas that came out of our first meeting.

What we did was to break up into six working groups, on communications, astrophysics, remote sensing, constructing facilities in space and a few others. We came out with a whole list of recommendations that we thought would be good for somebody (not us since we're just an information agency), to put into effect.

Let me be slightly formal about what I think we ought to do, since all of us are engaged in the ISY activities. It seems to me that we should concentrate on maybe half a dozen goals. You can list your own favorites. I have five written down — promote international cooperation in space; promote the use of space to serve human needs; promote greater understanding of the earth itself (which is, of course, why the IGY was started, and why we think the ISY is a good sequel to that); promote a greater understanding of the interdependence of all people on the earth; and finally, develop an appreciation of the finite limits of many of earth's resources, and the need for us to tailor our use of those resources, so that those who come after us will find a successful environment in which to live.

Let me mention some of the ideas that came out of the National Academy of Sciences meeting with the Soviet Academy.

They had two general kinds of ideas. One, that you would call scientific, and one you would call educational.

Under the first heading, they listed x-ray astronomy, and they mentioned five different countries who had particular capabilities in that field, who ought to work together to make the best things happen.

Another topic they covered was radio astronomy, with a similar grouping of a number of countries.

They also referred to programs that are done in the U.S. only, which ought to be done internationally. For example, the Mars Observer is a U.S.-only activity, but there's no reason why we can't get other countries involved, and allow them to put their sensors on our spacecraft.

The same is true about going back to Venus. We have a plan to go back to Venus, and that need not be a U.S.-only initiative.

The National Academy of Sciences Committee made this statement: "1992 could be a milestone in the search for understanding of the earth."

It also said, "Several nations expect to have satellites and sensors as well as networks of earth stations that will permit, for the first time, continuous global observations of the processes at work on the planet that are responsible for a global environmental change."

Most of us in this room, I suspect, have been impressed with how many articles we've seen in the news in the last year or so about the changes that are happening around the world because of human activity.

Some people say, it's no big deal. Things come and go in nature, and nature has self-correcting capabilities, self-healing capabilities, so don't worry about it, it will all come out all right.

Others are terribly worried. The way to settle that debate, between those who think it's very disastrous if we don't do something different, and those who say no, it will take care of itself, is to collect more data. That's one of the principal purposes of the ISY, to establish a data-gathering program which would help to settle some of the issues about just how fragile this environment is that we live in.

One of the initiatives that came out of the education heading that I referred to a minute ago had to do with the role of communication satellites. Those of us in the developed world know all about the use of them. Some people think we have a glut of communication satellite activity in this country. I don't agree with that, obviously, but there are many countries in which satellites have not reached proper utilization. Many of the initiatives that we talked about in our Hawaii conference had to do with the role of these satellites on education, in the Third World.

**That's one of the principal purposes of the ISY, to establish a data-gathering program which would help to settle some of the issues about just how fragile this environment is that we live in.**

The Soviet ideas that were presented were many, and very interesting.

Many of them had to do with what is called space physics, studying background radiation noise, space plasmas, radiation from extremely low temperature objects in deep space, and missions to Mars and asteroids. They also talked about opening up a number of the missions-which had heretofore been restricted-to any space-oriented country that wanted to participate. It seemed this was good evidence that Glasnost might actually be coming about.

As a follow-on to the conference we had in Hawaii, we have another conference coming up, which I'm happy to be participating in, on a subject which is dear to my heart. It is called Mission to Planet Earth.

There are several designations for what we call Mission to Planet Earth. Some people talk about the same subjects and call it Global change.

Other people use the term, which they call IGBP, the International Geosphere-Biosphere Program.

Many people believe that what's happening in the biosphere, including human activity, is affecting what happens in the geosphere, inanimate activity, and that we have to pull these two together. They say that if we don't look at them simultaneously, we'll never get a true understanding, because the two interact with each other.

Someone asked me earlier today, is the ISY 1992 limited to one year?

The answer is it's going to be like IGY. We set out to make 1957 a one-year program, but the work spilled over. It took most of 1958 to get the projects completed.

Also, there was a sequel to all those projects. Having put up one small satellite, and seeing what it could do, people wanted a bigger satellite, and so the work went on from there.

The same will happen in the ISY. 1992 will be the year, but the activity will spill over into the 21st Century, and for a considerable time thereafter. So, it will be a long-term activity.

One thing that will be different from IGY: the ISY will include a much broader range of people with different kinds of specialties.

IGY was mainly a scientific year. Many scientists, a few engineers, but mostly scientists, collected data about the earth. ISY, as I said earlier, will have an order of magnitude more people, all qualified to participate. These people will not be just scientists, but also industrialists, and engineers. They are professionals of all kinds, who have an interest in seeing that the activity in space is promoted, and that the activity which does take place results in good things for people on earth.

**Back 30 years ago, when the NASA Act was passed...we thought we knew what leadership meant**

Another group, which I hadn't mentioned so far, is the professional societies. When we met in Hawaii, two professional societies were represented. One was the Electrical and Electronic Engineers group (IEEE), and the other, the Civil Engineers, ASCE. The civil engineers are planning a conference concerning construction on the moon and on the planets.

Gene Cernan mentioned something a minute ago, which is also an item that I think about quite a lot, and that is something called U.S. leadership in space. Back 30 years ago, when the NASA Act was passed, called the "Space Act," we thought we knew what leadership meant, and we were sort of in a bind, because the Soviets had put up the first satellite, and we had come along second.

The act said, we want leadership, and so leadership is a very strong part of the Space Act of 1958. I think that was very appropriate, and it had some very good consequences. At that time, there were only two powers capable of going into space. How many are there now? In connection with a project on earth remote sensing, we recently put together a list of those countries that either have projects underway, or are starting projects to put satellites in orbit to look at the earth. The number of countries is 24!

We've gone through the situation where there were only two space-capable powers to one where there are, let's say, two dozen, with others coming along.

Leadership in today's environment means something different than it did when there was only one other guy in the act.

To my way of thinking, a space race between the American and the Soviets doesn't make sense anymore.

What about those other 22 countries? We have to find a way of working with all of these, and to my way of thinking, the best way to work with them is on a cooperative basis. Now, you won't find ways to cooperate with every country on everything, obviously.

I cite as an example what Jim Beggs did when he got approval to start pushing for the space station. He went around the world, he signed up the Canadians, and the Japanese. He signed up the European group, and he came back with a successful international program in which the U.S. leadership role has been properly defined and properly laid out, properly presented to our friends and allies. I think that is the way to go, and if we move along those lines, then there will be many cases where the U.S. can show leadership.

**To my way of thinking, a space race between the American and the Soviets doesn't make sense anymore.**

By the way, there will be countries, like the Soviet Union, the French, and various other countries who will show leadership also and that's the kind of world it is. We're not in a bipolar world. We're in a world where there's room for U.S. leadership. There's a crying need for U.S. leadership, but we're not going to be the outstanding player in every ballgame.

It's interesting that the Soviets have recently adopted an attitude of international cooperation.

I think back about the goodwill that's been generated in the United States through space cooperation. Some of the NASA people here can give you better figures than I, but it's something like 1,000 cooperative projects that we have conducted with 100 different nations.

The amount of goodwill that's redounded to our benefit as a result of all that work is tremendous. The Soviets have learned lessons from watching the U.S. It's quite evident that international cooperation is the way to go. You get brownie points for it, and so they're giving up their secrecy and signing up countries right and left on international cooperative space projects.

On the Mars Phobos Mission, they have a total of thirteen countries involved in that one project. And they are making a big thing out of ISY.

I was in the Soviet Union on October 4th, which was the 30th anniversary of the Sputnik launch, to attend a conference which they had convened. They invited 400 outside people, scientists and engineers, industrialists and academicians to participate in a symposium to talk about where to go in space. They did a bang-up job. They did a professional job. Sometimes, we've gone to

Soviet affairs where we've seen Soviet presentations that were not very professional. In this case, this conference was run the way a conference ought to be run. It was a first-class, a world-class event, and they made a lot out of the International Space Year.

The closing statement that came out of that conference said, "ISY is the best concrete manifestation of the desire by nations for greater space cooperation."

All of us know that going into space, going to Mars, and so on, is going to be a very expensive proposition, and that we're going to need the cooperation of other people to help share the costs. Of course, international cooperation is not a winning game if you don't have a good hand of your own. The United States must enter international cooperation from a position of strength. But I think that such activity is a must, if we're going to do all the things that we want to do, and ought to do, in space exploration.

**"ISY is the best concrete manifestation of the desire by nations for greater space cooperation."**

Now, you don't rush into an international venture just hoping for the best. I think what you have to do is you start small, and you work up.

Some people say, would you be willing to go to Mars with the Soviets? Well, my quick answer to that is, it all depends on what we've done in the previous 25 years before you ask me that question.

I think it might take 25 years before we agree that we would want to send a team of people to Mars with the Soviets. I don't know how long it would be, but I know that there's a period where you have to go through a confidence-building kind of an activity. Eventually, you will get to the point where you can answer that question properly, and, of course, it may be no, but hopefully, it might be yes.

I think the Mission to Planet Earth is the ideal area for international cooperation. Whatever term it goes by, Global Change, IGBP, or whatever, I think that one of the best examples of international cooperation is where every country on this earth receives data, as to what is happening to our environment. Some of you have heard me promote an international cooperative venture called Global LANDSAT. John McElroy uses the term ENVIROSAT. I stopped using Global LANDSAT, and I talk about ENVIROSAT, because I like that word. I'm not quite sure what it means, but I like the sound of it. You've got a cooperative program where various space-capable countries have participated in putting together the satellites, the ground stations, the software, all that's needed to collect the data that you need; and that you have worked out a scheme whereby all nations who want that data will participate in paying for it, and everybody will be a winner.

**I think the Mission to Planet Earth is the ideal area for international cooperation.**

Well, it's time for me to bring this talk to a close, and I guess I'll do a silly thing here. I will quote myself from a paper I wrote in Moscow, when I went to that symposium.

"The earth's resources are, in many ways, finite. The earth is a closed ecosystem. Pollution spreads worldwide, the oxygen, carbon dioxide and ozone balance of all these affects all of us. The problems with food, disease, economics, technology, these are all becoming worldwide issues. We know in our hearts that we must begin to see ourselves as citizens of the world, citizens of Planet Earth.

"Let this be the legacy of Sputnik and Apollo. Let us accept our heritage proudly, and join in using space for the benefit of all people."

I think that the ISY is a good vehicle to get many worthwhile things done.

ISY means different things to different people. Many people will use it to support what they were already doing, and claim that they started doing it because of ISY. Others will ignore it. Some will say it's a bad idea. OMB will say it's just a way to get more money out of them. I think it's one of the best ideas that's come along in a long time, and I hope that all of you representing different organizations, and especially the U.S. Space Foundation, will pick up the ISY idea. Gene, I hope you and many others will say my association, my foundation, my organization is going to do the following 12 things during the ISY, and during the years to get ready for the ISY. I think the results of such activity would be good for all of us. Thank you.

**MR. CERNAN:** John, thank you, for opening our eyes to something that a lot of us may not have thought of, and for your efforts in furthering those things that I think are near and dear to all of our hearts.

I would like to introduce Harriet, if I may; Mrs. McLucas, would you stand up, please.

I did that for two reasons, one because you're such a lovely lady, and the other is because you're the one who told me to tell everybody that he was Chairman of the Advisory Council. Only kidding.

I think that's all, Dick.

**MR. MACLEOD:** Thanks very much, Gene. We have a terrific program this afternoon debating this launch business, and then Moon, Mars and Beyond and what should happen. So get geared up for a good one.

# CIVIL PROGRAM UPDATES

*Moderator:*
**Dr. Radford Byerly,** Director, Center for Space and Geosciences Policy, University of Colorado
*Speakers:*
Space Station - **James Odom,** Associate Adminstrator for Space Station, NASA.
National Aerospace Plane - **Bob Williams,** Project Director, DARPA

*DR. RADFORD BYERLY, JR. (center) is the Director of the Center for Space and Geosciences Policy at the University of Colorado at Boulder. The Center's work focuses on social and economic impacts of changes in Earth systems such as climate change due to the carbon dioxide-greenhouse effect. Prior to coming to the University of Colorado, Dr. Byerly was Staff Director of the Subcommittee on Space Science and Applications, Committee on Science, Space, and Technology, U.S. House of Representatives, where his responsibilities included civilian space programs and their interface with military programs. He was with the Committee for 12 years (1975-1987) and prior to that managed programs of fire research and environmental measurement at the National Bureau of Standards. Byerly was trained in physics at Williams College (BA. 1958; MA 1960), where has Phi Beta Kappa, and at Rice University, Receiving his Ph.D. in 1967. He spent two years as a postdoctoral fellow at the Joint Institute for Laboratory Astrophysics at Boulder (1967-69).*

**MR. MACLEOD:** Good afternoon, ladies and gentlemen. We're delighted to start the afternoon with a panel moderated by Dr. Rad Byerly, the Director of the Center for Space and Geosciences Policy for the University of Colorado. Rad has a tremendous background in space. He's published **Commercial Industrial Uses of Space**. He's a member of AIAA; a member of the '85/'86 Advisory Committee on Space for the United Nations Association International Geosphere/Biosphere Program, and also author of "Decisions on Space Initiatives for the Planetary Presentation, a Case for Mars III" last summer.

Prior to coming to the University of Colorado, Rad was Staff Director of the Subcommittee on Space Science and Applications; Committee on Science, Space and Technology of the U.S. House of Representatives. His responsibilities included civil space programs and their interface with military programs. He was with the committee for 12 years, that is from '75 to '87, and prior to that, managed programs of research, and environmental measurement, at the National Bureau of Standards.

Rad was trained in physics at Williams College, where he got his B.A. in 1958, and an M.A. in 1960. He was Phi Beta Kappa there. At Rice University, he received his Ph.D. in '67, then spent two years as a postdoctoral fellow at the Joint Institute for Laboratory Astrophysics at Boulder, so you can see why he might have wanted to come home.

It's a great pleasure now to introduce the moderator for the first session this afternoon, Dr. Rad Byerly.

**DR. BYERLY:** Thank you for that nice introduction.

Two programs that we are going to hear about may dominate the way we do business in space in the next several decades:

Space Station programs should lead to the ability to do routinely in space many things that we now can't even do at all.

Having a Station in place with a crew aboard, together with the necessary equipment, such as space tugs to bring satellites to the Station for servicing, will allow us to design and operate satellite systems in fundamentally different ways.

There's a great potential for increasing overall systems reliability and decreasing costs. Of course, there's also a potential for fundamentally increasing our ability and our opportunities for doing micro-gravity research.

On the other hand, there is a danger we have to guard against.

The Station is going to be up there for decades. We have to ensure that the basic operating costs, just the cost of keeping it up there — the housekeeping budgets — don't absorb the money that we're going to need to do the research aboard the Station. We can't spend all our money running the facility and not have the money left to do the research.

So we're very fortunate to have a person like Jim Odom running the program, as the Assistant Administrator for the Space Station. He's got a record of successes at NASA, and I think he'll be able to deal very well with these kinds of problems.

Second, we're going to hear about the National Aerospace Plane from Bob Williams, who is the DARPA project director. Bob has done an excellent job of turning a concept into into a fast moving development project. The NASP, like the Station, holds potential for revolutionary advances. If we can greatly simplify and reduce the cost of getting into space, the whole way we do business could be changed. We certainly have to pursue this opportunity vigorously.

However, there are some dangers here too, dangers of over-promising, but that's not a good word, because that would imply that Bob is over- promising, and he is not. I think there is a danger that some people are over-enthusiastic about the program, and are trying to take it and run with it.

First, let's talk about the need to reduce costs.

While I think everyone agrees that technology can enable lower costs, what I do not see yet is the economic incentive that will drive the costs down. How will we do business differently so that there's an economic as opposed to merely a political incentive to lower costs?

Second, there are those that believe strongly in NASP; they advocate immediately putting payloads aboard it, before it's even built. It seems to me that's the kind of thing I was referring to, where some people see a little more than is there at the present time.

One would hope that the shuttle accident has demonstrated the need for a robustly redundant national launch capability, and the need to move ahead on many fronts at the same time.

So that's all I want to say this afternoon about two terribly important programs, things that we really have to move ahead with very vigorously.

We're now going to hear from Jim Odom, who has been at Marshall Space Flight Center for about 30 years. For several years, he was manager of the shuttle external tank program. He spent three years getting the Hubble Space Telescope program back on course when it wandered off a little bit a few years ago, and immediately before assuming his present position, he was Director of Science and Engineering at Marshall. So, Jim, please.

**MR. ODOM:**. Thank you, Rad. I can't pass this occasion to recall that years ago, when Rad was on the Hill, he would come around and review my programs rather regularly. It's a bit more pleasant to be on the same side of the table with him today rather than him talking to me seriously about the cost of the program or how much it was behind schedule. So, Rad, it's a pleasure working with you again, and especially in this role.

I would like to take a few minutes today and give you a feel for the program, let you know a little bit about the history. As I look out over this group it's obvious that many people, here and across the country, have been involved in Space Station for well over a decade in varying degrees. Obviously, the thing that certainly sets this program apart, as Rad has said, is that it is the next logical step for our space program. It's a pleasure for me to be here today, and to give you a status of the program, where we think it's going and a little of the environment that the program is operating in today, both within the agency, nationally, and certainly within the governmental bodies.

**America is greatest, when we dare to be great.**

*JAMES B. ODOM is the Associate Administrator for the Office of Space Station. He was appointed to this position on April 1, 1988. Prior to joining Space Station, Mr. Odom served as the Director of the Science and Engineering Directorate at NASA's George C. Marshall Space Flight Center in Huntsville, Alabama. He assumed that position in November 1986, after serving as manager of the Space Telescope project for three years. Mr. Odom began his engineering career with the Chemstrand Corporation in Decatur, Alabama. In 1956, he joined the U.S. Army's rocket research and development team at Redstone Arsenal, Alabama, as a systems engineer and transferred to the Marshall Space Flight Center in 1959, prior to its formal establishment in July 1960. At the Marshall Center, Mr. Odom held various engineering and technical management positions. He was actively involved in the development of earth satellites and unmanned space probes prior to his assignment of chief of the Engineering and Test Operations Branch for the second stage of the Saturn V launch vehicle. In 1972, he was appointed manager of the External Tank Project in the Shuttle Projects Office. In 1982 he became deputy manager for production and logistics in the Shuttle Projects Office. He became manager of the Space Telescope Office in 1983. Mr. Odom attended Troy State College and Auburn University. In 1955 he received a bachelor of science degree in mechanical engineering from Auburn.*

The President's State of the Union message on January the 25th, 1984, gave the Program it's start. There were two main points in his commitment to the nation and his direction to NASA and the aerospace industry at that time.

The first point was that America is greatest, when we dare to be great. I think we've lost a bit of that initiative in the last few years, in our agency, but also in our industry.

I'm delighted to see us, I believe, turning a corner, not only in our own industry, but certainly across many other industries, especially those that have national competitions.

I think it's absolutely imperative that we turn that corner.

The second point in President Reagan's message to our nation in '84, was that the Space Station would be an international program which will put men in space for long periods of time.

We have been criticized, and I think rightfully so, not only as an agency, but also as a nation, for not having a strong space policy. I think we have turned that corner also.

There are varying degrees of acceptance, and a lot of people still may feel that our space policy is not as strong as it should be. I think it is an excellent framework by which we can turn ourselves and our industry around and take a different tack.

**"A fundamental objective guiding U.S. space activities has been and continues to be space leadership."**

I think that if you look at certain items in the pace policy, they drive the Space Station in its mission.

The President set forth a direction for us to put men in space, to increase our technological capability in space, and at the same time foster a very strong international program. President Reagan has said that the Station should basically be a research facility, a laboratory in space that we can all be proud of; it should be versatile, and user friendly. To me, one of the most important aspects of that space policy and the direction that the President has given us is in the last line: his directive states that, "A fundamental objective guiding U.S. space activities has been and continues to be **space leadership**." I underline those last two words, because as we have heard today, as we've heard yesterday, and as we will hear more the rest of this week, we do have competitors. We do have people who are interested in getting just as involved.

I think it's extremely important that our programs be international in nature, like the Space Station, as well as many others.

We've learned how to cooperate with other nations on space projects in recent years, and I think that as our world gets smaller, it's going to be even more imperative that we create international environments, international causes and international solutions to problems that we all share.

Let me talk just a moment about the Congress, and where it is relative to the Space Station.

I would not be so bold as to say that I really know its position.

We've had a lot of input lately. We've had a lot of strong support. If you look at the floor vote by the Senate last year on the budget, and more specifically, the Space Station, the vote was 84 to 12 in favor of the NASA budget. It's very infrequent in the Senate, that you find a vote which strongly supports an agency's budget.

I was in one of our senior senator's offices just yesterday afternoon. I believe and he believes that we will share almost an equal interest, certainly, on the part of the Senate as they go through their deliberations this week and next.

He was very optimistic. However, I think we should not cheer up too soon. We still have to go through the House. We have a lot of hearings taking place next week. They will be a little more difficult.

**The evolutionary aspect of the Space Station will provide us with the capability to develop those technologies that are not in hand this year.**

Any program, especially a new program the size of the Space Station will get a lot of attention. Clearly, it's going to be expensive in the environment that we are living in today. I think it's fair to say that the agency will be getting a fair shake; I believe space programs outside of NASA will be getting a fair shake. This is going to be a long, hard summer, and I think there will be another one next year. However, I feel very positive about the support that we have received so far, and I think it will allow us to create an excellent program.

Some of our Congressmen are interested in automation and robotics. Many have felt that the Space Station should be leading that technology development, and there are areas in which a Space Station will do that. I don't think we've found all of those yet, but the evolutionary aspect of the Space Station will provide us with the capability to develop those technologies that are not in hand this year. Next year, and during the early years of the design, we will be including the hooks and scars to provide the capability to add new technologies.

As you've heard Rad say, operation of the Space Station is of great concern to us. We are concerned with the life cycle costs of the Space Station; and I think one of the most demanding challenges we face in the program is understanding the operation well enough to design the proper requirements in, or the capability for those operational requirements early on in the program. This makes this year's, and next year's attention to operations extremely crucial.

Many people on the Hill would like to see us provide a man-tended capability well ahead of the permanently-manned capability. We have just finished a study in which we re-examined the actual weights, the volumes of the subsystems and the systems as we now understand them. The launch sequence that we have laid out, which I am pleased with, shows us putting up the laboratory module on the fourth flight. That allows for research capability prior to the permanent manned capability. That, I think, is an excellent sequence for implementing the program. It's very logical, and I'm very glad to see the early man-tended capability coming into the program.

The Industrial Space Facility: I think I'll not address that one. It now has a new name; it's called the Commercially Developed Space Facility. As many of you know, it received a lot of attention on the Hill, and in the Executive Branch over the last few weeks. Since it is not necessarily coupled with the Space Station, I will just move on.

Science and other payloads will be very crucial to the productivity of the Space Station and I think these areas are extremely important to the relative versatility of it. That will get a lot of attention. The work packages have received a lot of attention, how the program is divided up among the contractors as well as among the NASA centers.

The cost and schedule will always be crucial in this program and any program that we have.

One point that is extremely important, especially on the Hill, is the use of the Space Station for peaceful purposes. I'm very comfortable with the relationship that the Space Station now enjoys with DOD.

Congress has certainly mandated that we generate a number of reports. We've finished up most of the studies but we have a couple more that we will be submitting to them in the next two or three weeks. I believe we're very close to having an understanding, both within the agency, and within the Congress, as to what the final configuration of the Space Station is.

**I'm very comfortable with the relationship that the Space Station now enjoys with DOD.**

I will show you a picture a little later of what the Space Station will look like. The picture reveals the science and application capability and should stimulate advanced technologies. This is an area I think, as a nation, where we have lost our grip on applying the literally thousands of good ideas that are generated in our laboratories, our agencies, and even more importantly, in our universities. It takes us much too long to get these ideas into the marketplace. That's an area that I think we have got to find ways to deal with. I see a lot of activity now in the National Academy of Sciences, the National Science Foundation and several professional societies in trying to deal with that. I think that its a good place to start working the problem, but it can't stop there. Each government agency and each company must generate and apply ideas because we have got to be able to be more competitive and shorten the time for good ideas to be marketable items.

Challenging the Soviet lead; that's a topic I don't think we have to talk about at all. We understand that. We understand a lot of their programs, and where they're going. If you look at the sheer tenacity, and the consistency of the Soviet building blocks, there's a lot that I think we ought to be learning from. We are not taking advantage of lessons learned.

We need to stimulate the interest in science, engineering, and education; as we heard from Rad earlier, I think there are a lot of programs in our country by which that can be done. NASA is trying to put more and more emphasis into university programs and I'm delighted to see that. We have to be concerned that graduates are available to us, in our science and technology fields, and I hope our Space Station will help to stimulate interest here.

One of the areas that we're really trying to understand is how to design, build and fly experiments in approximately a two-year period. That's a real challenge, but if we want to stimulate the universities, and the research people, I think we've got to do it better and more efficiently.

Now, I mentioned the international environment in which we're working. We have a very good relationship for Space Station development; much of which you heard about earlier this morning. The Canadians will be supplying the multi-servicing system; Europe will be supplying an attached pressurized module as well as a polar platform, and also a man-tended free flyer, and the Japanese will be supplying a module.

International cooperation, as I said earlier, is absolutely imperative. The smoother the cooperation, the more effective the program will be. The more convenience we allow for their instruments to fly in our laboratories, and our instruments to fly in their laboratories and platforms, the more science, mutual interest and mutual cooperation we will generate.

The MOUs and the IGAs, between ourselves and the three parties started back in '85.

They are virtually complete now. I hope within the next few weeks we will have all of the intergovernmental agreements signed as well as the MOUs between NASA and the counterpart agencies. It's certainly been a cooperative operation during the design phase. We have representation from each of the three countries in our Reston, Virginia facility, so they are an integral part of the team.

Now, let's look a little bit more deeply into the real objectives of the Space Station. It's certainly to design and to develop a permanently manned capability by the mid '90s, and we certainly are on the track to do that. It's also, as Rad indicated, to provide an affordable facility and affordable capabilities for the user community to enhance science and applications. This is an area that I think we were a little bit behind the power curve in getting

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the science community, and the user community, involved in the early-on architecture of the Space Station.

Just a few months ago, we had a user meeting at Huntsville, Alabama, and invited approximately 150 potential users or representatives of users to that conference. This resulted in good news and bad news. The good news is that they came up with a tremendously good list of potential candidates for early-on use of the Space Station. The bad news is that they oversubscribed us already on the first list. Now that is great. From that list will come the opportunity not only to pick the best science that we can come up with, but it also gives us a framework to understand our relationships; to understand the use and the accommodation of the experiments, and certainly to secure international involvement. The Station is designed for evolution.

As I mentioned, many of you who have worked in long-lived programs know that after ten years, you have to start worrying about the components, the parts and even the spares. A 30-year program must be designed up front with an evolutionary capability. That's true both in the hardware, and especially in the software.

You will see us pushing very hard early on to get quite far along in automation and robotics, especially in the involvement of artificial intelligence to analyze the operation of the Space Station.

I think that A.I. is a good example of that kind of activity; it's imperative that we put all the proper hooks and scars in place so that we can then take advantage of current technology in the next 10 or 15 years. And as I mentioned, we will be pushing automation and robotics and we will be blending both manned and unmanned systems and capabilities in the Space Station.

This is what the Space Station looks like. I've mentioned the ESA involvement in the platforms, and in the pressurized module, I've mentioned the Japanese — and here is an indication of how the work packages are divided up. Goddard will be supplying the platforms and a lot of the servicing capability. Marshall will be supplying the pressurized modules, the nodes, the environmental control, the life-support systems, the audio-visual systems. Johnson will be providing the large structures, all the demand systems, outfitting the hab module, and all the crew system and crew-related hardware. NASA/Lewis will be supplying the basic power system.

Now, just to say a few words about the Space Station team. We have a technical management and information system. This is an automated management system for both documentation of engineering data as well as cost data. I think this system is absolutely imperative for a program that is as diverse and as spread around the world as this one. We also have something I'm very delighted to see, and that is a software support environment. This is a process to develop all the rules and tools of the next generation of software for the Space Station, including software developed internationally. I think it is something we will plow through and learn a great deal about in the future, especially regarding complex software systems.

I'm very delighted with the contractor team that we have on board: Boeing, General Electric, McDonnell Douglas and Rocketdyne. We have a support contract with Grumman, which we call PSC; that is the integration support to Level 2 at Reston. We also have a Flight Telerobotic Servicer contract — it is in Phase B right now — with Grumman and Martin Marietta. It is directed by Goddard Space Flight Center.

The Space Station is going to be a research facility, and a platform for observing spacecraft and observing experiments. We plan for it to also be the building block for further exploration of space, to the planet Mars, and also to a lunar base. However, one area that doesn't get as much attention as I think it should is the support that the Space Station will be giving to the Mission Planet Earth Project. That's one area that I personally am very encouraged about, and look forward to seeing. I certainly agree with John McLucas, that "Mission Planet Earth" is one of the things that really provides a lot of the glue, because I for one do believe that we live on a fragile planet, and I think it's going to be incumbent on all of us to understand how fragile; to understand the controls, what we're doing to it, and to avoid damaging it.

**Once we get the facility up there, get it checked out and get it manned, that's just the beginning.**

The Space Station is a commercial endeavor. We do have requirements for all of our primes to come in with commercial proposals to us. These are in the works right now, and we will be reviewing these proposals in the next few months.

As I mentioned, it is an evolutionary spacecraft, it is not an end unto itself. Once we get the facility up there, get it checked out and get it manned, that's just the beginning.

The real program is the next 30 years, and to that end, we are all dedicated to making those productive years on Space Station. I think, with the support of people and organizations like this one — and I commend Dick for the theme of this conference — it's imperative that we look to the Space Station as our next logical step, and we're looking forward to it. I'm very comfortable with the configuration, the organization that I have, and I look forward to getting on with it.

**DR. BYERLY:** Thank you, Jim. I think we all get a feeling that the program is in good hands now.

In the interest of time, let's move quickly on to Bob Williams. He's one of those rare birds, a native Washingtonian. He's been at DARPA for 18 years, and during that time, before working on NASP, he's been involved in research of the X-wing aircraft, the high-altitude, long-endurance aircraft, among others. Before DARPA, he

**was involved in research at the Navy's David Taylor Model Basin. Bob, please.**

***ROBERT WILLIAMS is the Program Manager for the National Aerospace Plane with the Defense Advanced Research Projects Agency (DARPA). His career with DARPA has included work on such programs as the X-Wing Aircraft, the High Altitude Long-Endurance Aircraft, Advanced Propulsion, and Aerospace Plans. Prior to coming to DARPA, Mr. Williams was with the David Teller NSRDC (Naval Ship Research and Development Center) and the Naval Air Tech Center, both in Washington, D.C. Mr. Williams is a graduate of Virginia Polytechnic Institute in Engineering Mechanics and his post-graduate studies were in Theoretical Aerodynamics at the University of Maryland and in Propulsion and Aerial Acoustics at the University of Southhampton, U.K. He is a native of Washington, D.C.***

**MR. WILLIAMS:** Thank you, Rad. The only correction I'll make on that is that no one stays at DARPA 18 years. I have been there six, and I'm becoming the old man of DARPA!

It's a pleasure to have the opportunity to give you an update on the National Aerospace Plane. Last year, I introduced you to the program shortly after it had been kicked off. This year it's appropriate to review the status.

The first thing that I want to tell you is that our goals have not changed. The aerospace plane, the X-30, is an experimental flight research vehicle. It is in the same vein as the old XP-59 Aero-Comet that was the first manned U.S. turbine airplane. We believe this will be the first manned U.S. scramjet powered aircraft. It's an air breathing vehicle designed to take off and land on conventional length runways; to fly to polar orbit for our demonstration flights, (or easterly if we want to increase payload); to have the ability to demonstrate a powered go-around when we come back should we wish to abort a landing or divert to another field; to have cross-range capability. Fundamentally the X-30 will demonstrate those critical technologies for hypersonic flight which will enable us to understand the full implications for military and civil vehicles for the next decade.

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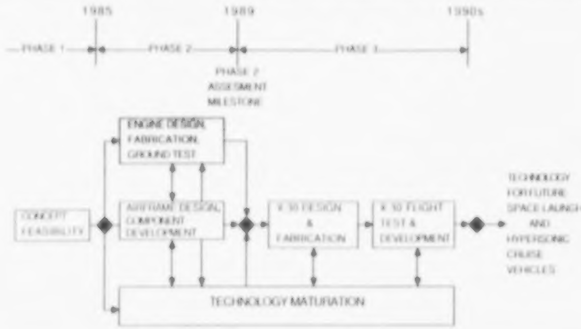
| SINGLE-STAGE-TO-ORBIT: | • AIRBREATHING PROPULSION MACH 0 TO 25<br>• HORIZONTAL TAKEOFF AND LAND<br>• INTEGRAL TAKEOFF/LANDING GEAR<br>• TWO MAN CREW<br>• INSTRUMENTATION PAYLOAD<br>• FULLY REUSABLE FOR 150 FLIGHTS |
| SUSTAINED HYPERSONIC CRUISE: | • AIRBREATHING PROPULSION FOR ACCELERATE AND CRUISE<br>• TRANS-OCEANIC RANGE UNREFUELED |
| SUBSTANTIAL CROSSRANGE AT REENTRY/LAND: | • AIRBREATHING PROPULSION FOR LANDING |
| POWERED SUBSONIC GO AROUND AND FERRY: | • EFFICIENT AIRBREATHING SUBSONIC PROPULSION AND AERODYNAMICS |

In particular, it is a program of focused technology and research, directed to the development of two flight demonstrators. We call it the X-30, because we think it's at least twice as good as the X-15. (I was pleased to hear Neil Armstrong voice that same view recently).

Our basic schedule for the program is shown in the next chart. It is a three-phase program. We are part-way into Phase 2, seeking to reach a critical technology assessment milestone; a go-ahead milestone in fiscal year 1990 to build the aircraft. Phase 2 has three major pieces: engine design and development, airframe design and development, and a program of technology maturation.

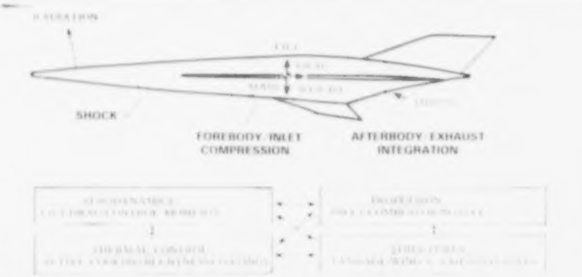
**NATIONAL AERO-SPACE PLANE PROGRAM**


1985
1989
1990s
PHASE 1
PHASE 2
PHASE 3
PHASE 2 ASSESMENT MILESTONE
ENGINE DESIGN, FABRICATION, GROUND TEST
CONCEPT FEASIBILITY
AIRFRAME DESIGN, COMPONENT DEVELOPMENT
X-30 DESIGN & FABRICATION
X-30 FLIGHT TEST & DEVELOPMENT
TECHNOLOGY FOR FUTURE SPACE LAUNCH AND HYPERSONIC CRUISE VEHICLES
TECHNOLOGY MATURATION

We're very excited about our technical progress and what I want to do this afternoon is give you a general feeling for some of our accomplishments, and why we have the conviction that this is a program which is leading our country's aerospace future.

The first thing I should say is that we have come to understand, in an unprecedented way, the meaning of integrated airframe-propulsion.

**FULLY INTEGRATED ENGINE/AIRFRAME**

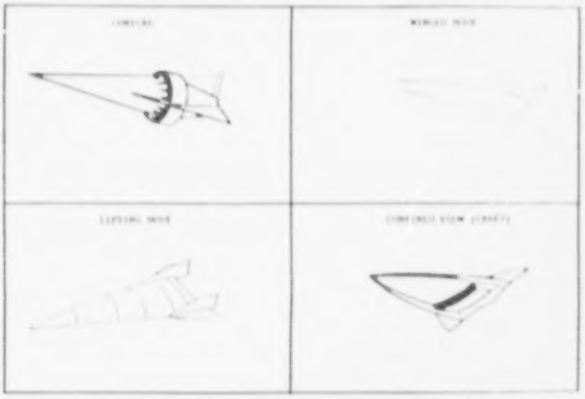


BEST COPY AVAILABLE

This aircraft is so fully integrated, that not only the aerodynamics are integrated to the propulsion system, but the structures, thermal and flight control systems as well. For example, whatever you do to the forebody of the vehicle influences the propulsion system, the drag, the heat loads, the control, and the structures. It's all wrapped up together. And it's an exercise in systems integration unprecedented in its scope (and probably also in its difficulty).

We've had an exciting year. We analyzed over 100 different configuration options during the past year. We went through a source selection, where we down-selected to six designs, that is, three airframe companies times two engine contractors, to give us six. The winners of that competition in the October time frame were the McDonnell Douglas Corporation, Rockwell and General Dynamics for the airframe work, and Pratt-Whitney and Rocketdyne for the engine work.

CONFIGURATION OPTIONS



**some of America's best designers were involved, the most creative ideas came forth.**

It was a very exciting competition; some of America's best designers were involved, the most creative ideas came forth. No, I'm not going to show you the winning designs; we worked too hard to get them and we don't want to hand that information away.

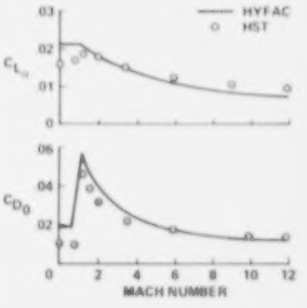
In the technology arena there has been a great deal of activity. We have been doing wind tunnel testing up to Mach 20. We have done over 20 tests in that regime. We are doing parallel fluid and thermal physics modeling in such areas as aerodynamic force and moments, boundary layer transition and understanding of the shock flows on the vehicle.

One example is a wing-body configuration, with analytical correlations for a Mach 10 data base. We feel pretty good about aerodynamic predictions on the vehicles, including, I might add, a basic understanding of transition phenomena.

AMES ALL-BODY MODEL

L = 3 ft

HYFAC/HST CORRELATION
AERODYNAMIC COEFFICIENTS
α = 5°

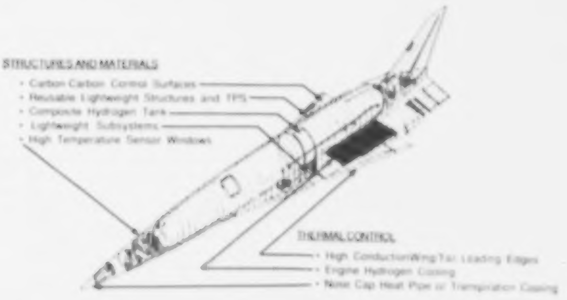


We've been doing a lot of fundamental kind of studies in this program, focusing work on shock-boundary layer interactions in critical regions. These computations involve the full equations of fluid flow, that is the Navier-Stokes equations for three- dimensional flows, applicable to the hypersonic flow regime with the various reacting chemical species involved.

Certain areas are extremely difficult to calculate even with the largest supercomputers. For example, where a shock wave intersects the lip of that scram jet engine, one gets a very complex multi-shock interaction, so we're also doing shock tunnel testing to develop a data base for empirical correlations in that regime.

We are of course very actively pursuing advanced structures. This work includes advanced structural test facility setups where we're actually developing new test techniques and instrumentation such as special strain gauges and high temperature thermal couples. From the analytical side we are developing aero-thermo-elastic finite element models to predict deformations under thermal loads and air loads transients. In summary we are generally attacking the structurals issue from a very multifaceted, inter-disciplinary standpoint.

STRUCTURES, MATERIALS, AND THERMAL CONTROL


STRUCTURES AND MATERIALS
• Carbon-Carbon Control Surfaces
• Reusable Lightweight Structures and TPS
• Composite Hydrogen Tank
• Lightweight Subsystems
• High Temperature Sensor Windows
THERMAL CONTROL
• High Conduction Wing/Tail Leading Edges
• Engine Hydrogen Cooling
• Nose Cap Heat Pipe or Transpiration Cooling

We're doing work with active cooling of components of the vehicle for areas of high local heating rates. For example, there are no less than ten different nose coding approaches that have been pursued here. We are screening those down to about three now. And similarly with leading edges. The rest of the vehicle employs 'passive cooling' and we continued to emphasize in the X-30 the development of advanced materials which will have full reusability. That is, materials that will not need to be replaced on the X-30 for at least 150 flights...and that's just for the X-30. We intend to raise that number as we mature the technology on the road towards operational vehicles in the future.

It's a fundamental precept to the X-30 vehicle that it be reusable, so that we can minimize the maintenance and turn-around time, and maximize the utilization of this class of vehicle.

In our materials development area, we've had a very exciting management innovation. Beginning in the spring of this year, we have brought together all of the diverse materials activities being done within the X-30 program into a more focused and structured development organization. The rapid solidification rate materials technology, a technology that grew out of DARPA some seven years ago, is now being put into pilot production. We're going to take this material and carry it all the way through a production scale-up, making large components of the air frame fuselage and wing body structure.

This is a fascinating process where we rapidly solidify a molten metal by letting it pour onto a spinning disk, which in turn slings it out very rapidly breaking into extremely fine particles, which are 'frozen' by streams of helium. Cooling rates on the order of a million degrees per second lock in the properties of these advanced titanium aluminide materials. That's the rapid solidification rate process going on at Pratt-Whitney, McDonnell Douglas, Rockwell and a number of smaller companies in the country.

Another interesting activity is what we call XD Ti-aluminide. This is where tiny, sub-micron 'dispersoids' or particles of various types of metals are introduced into the primary material 'locking up' the slip planes and produce higher strength or higher stiffness properties.

We're getting to the point with this technology that we can actually create what we call 'designer materials'. We can work the formulas of the materials for high ductility, high stiffness, strength, or toughness depending on the properties required on the particular regions of the vehicle. Designer materials: a trend of the future that we're beginning to realize in our program today.

Composite materials form a major sector of our materials program. We are now employing what I call second generation carbon-carbon materials, where we're now going to three dimensional shapes which have coatings properties of much longer lifetimes than their predecessor systems used on the space shuttle. Furthermore they are for primary load-carrying structures, in contrast to current applications of carbon-carbon materials.

Inter-metallic composite materials, composed of the titanium aluminide materials I referred to earlier but now compressed into a matrix of silicon carbide fiber is yet another NASP material under development.

The materials program also has a fundamental activity going on at the universities and research centers in such areas as special coatings for oxygen and hydrogen embrittlement protection.

All of these activities, and more, are incorporated into our new NASP Materials and Structures Technology Maturation Program to reduce risks and uncertainties of the X-30 . What this really means is that we have brought together in a unique organization the five prime contractors of our program, each of them having responsibility for a major materials system. They are working together in a 'consortium', where technical information is shared directly. They actually subcontract to each other to do work.

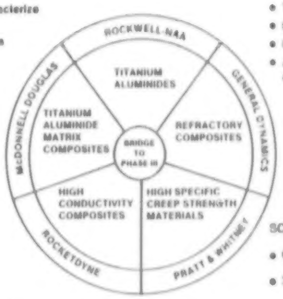
THE NASP MATERIALS/STRUCTURES MATURATION PROGRAM REDUCES RISKS AND UNCERTAINTIES

OBJECTIVES

- Develop and characterize materials
- Develop processes
- Verify materials and structure applications
- Demonstrate producibility

PROGRAM BASIS

- Team participation
- Material concentration
- Results shared
- Associate contractor agreements executed



MANAGEMENT

- NASP JPO
- Executive Steering Group
- Joint Management Team

E-88-0160

SCHEDULE AND RESOURCES

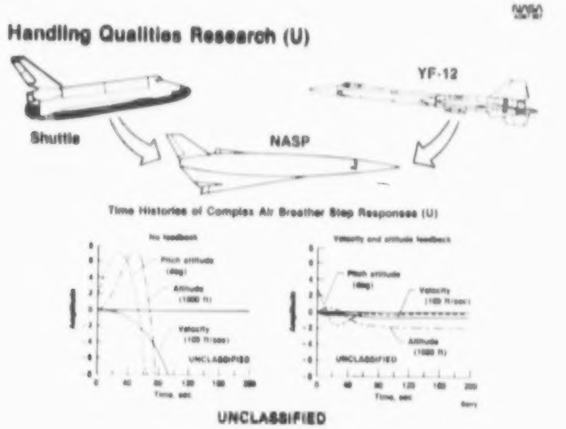
- Contract start March 1988
- 3 yr program
- $140M total
- $26M FY 1988

For example, where McDonnell Douglas is leading work on a composite inter-metallic metal matrix composite, the forming of the large part will be formed in Rockwell's large scale press. The carbon-carbon work being led by General Dynamics has a vendor base wherein about 70 percent of the funds going to General Dynamics, focused on their tasks to build a large section of air frame, goes out to a subcontract base of universities, research centers and vendors throughout the country.

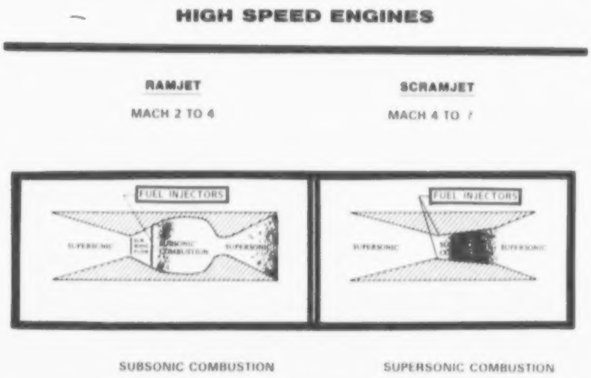
The engine companies are extremely interested in materials which have high thermal creep resistance and high ductility, and they are developing those materials in this consortium. It is an unprecedented materials development activity worth over $150 million. It also involves the major government research centers, doing fundamental testing, helping to develop math models, and so on for the advanced materials. It's an integrated team that we are very proud of. Although it's just getting launched, it builds on the extensive work that was already going on in the program.

One final point I would like to make about this consortium is that, up to October, we had many more material systems in the program. The competition for airframes and engine designs was also a competition for materials, because when we did our down-selects, we selected out certain materials that allowed us to focus on the ones that we're going to go ahead with for the X-30 program, and therefore to concentrate our resources. This is the 'necking down' process that we have had planned all along on the program which requires a very dynamic management style to implement.

Other work going on in the airframe side includes handling qualities research simulation work to look at the innate characteristics of a highly slender aeroelastically and aerothermoelastically deformable vehicle actually doing flight tests with advanced techniques for landing visibility where we have to retain the smooth contour on the forebody, which normally restricts the pilot's vision.



Turning to propulsion, the chart shows the basic comparison of the ram jet and scram jet engine. You may recall from last year that the technique is to convert from the 'subsonic combustion' ram jet mode to the 'supersonic combustion' ram jet mode by "swallowing the shock," where we change the internal geometry of the engine and suck the shockwaves downstream. When the aircraft is flying close to orbital speed the velocity through the inside of that engine will be on the order of 23,000 feet per second, and the only thing that will burn in those kind of conditions is gaseous hydrogen. The challenge is how well we can get the fuel to burn, how to inject it to encourage mixing and combustion and so on.

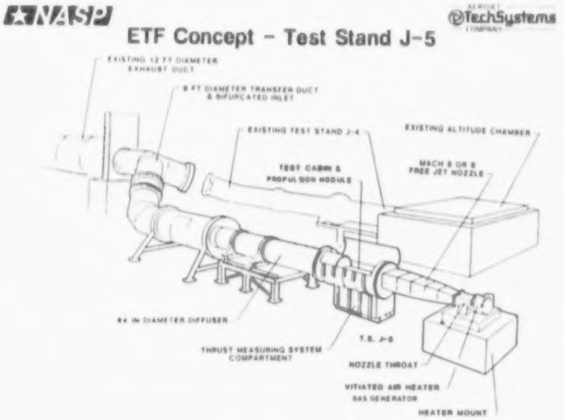


The way we're resolving these issues is by high-powered computation methods and special impulse facilities. We currently have some ten super computers running throughout the country, but not to rely on those solely, we're also conducting an intensive experimental test program.

From a design standpoint, we're particularly concerned about separating the air flow inside the engine. To be efficient we have to compress the flow rapidly through a system of shockwaves but we must avoid doing that too aggressively, to the point where we separate the flows and produce excessive losses. There's a design tradeoff there and fortunately we now have the tools to do this job properly.

There is an installation in the Cornell Aeronautical Laboratories 96-inch shock tunnel facility, where we have a man-sized combustor installed (a semi-direct connect rig). What we found in the NASP program is that shock tunnel facilities can be extremely useful in obtaining propulsion data at the ultra-high speeds. We found that a slug of fluid 3 to 5 times the length of the model is sufficient to set up steady state conditions for mixing and combusting fuel. It allows us to use impulse facilities extensively to cover the big hole that the nation has in hypersonic testing. They're not as good as continuous test facilities, but they don't cost the national budget to build either! For our best velocity capability, we went overseas and borrowed from the expertise developed in Australia at the University of Queensland. Dr. Ray Stalker there has developed a technology called the free piston driver shock tunnel which is a major innovation of the technology of shock tunnels. It allows us to get stagnation conditions much higher than ever achieved; velocities in excess of 30,000 feet per second, and to do this without having large dissociation of the gases in the flow. We are planning to build some of these tunnels in the United States to continue this work.

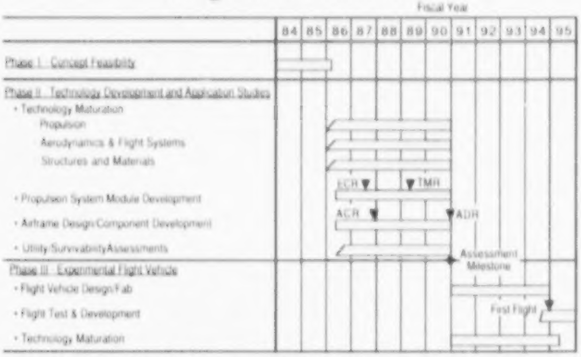
The engine development work that the contractors are doing will result in testing in an experimental facility shown on the next chart. There are actually two


NASP
AEROJET TechSystems COMPANY
ETF Concept - Test Stand J-5
EXISTING 12 FT DIAMETER EXHAUST DUCT
8 FT DIAMETER TRANSFER DUCT & BIFURCATED INLET
EXISTING TEST STAND J-4
EXISTING ALTITUDE CHAMBER
TEST CABIN & PROPULSION MODULE
MACH 5 OR 8 FREE JET NOZZLE
64 IN DIAMETER DIFFUSER
T.S. J-5
THRUST MEASURING SYSTEM COMPARTMENT
NOZZLE THROAT
VITIATED AIR HEATER GAS GENERATOR
HEATER MOUNT

of them to provide redundancy in our program: one at the Aerotech Tech Systems, and one at Marquardt. These will allow us to test full-scale flight-type modules of the X-30 propulsion system (up to Mach 8 a single module of an array of modules underneath the vehicle).

The last chart is our schedule again. It's probably important that people recognize that the schedule has three major elements: Propulsion development, airframe development, and technology maturation. The funding going into this program is about 85 percent basic technology development; and only about 15 percent in the design arena. We are focusing technology development by a convenient design actually. That is the way the program is constructed. It is controversial to do a program with this degree of concurrency of evolving technology at the same time we're doing design, but I want to make it clear that we're finding this to be extremely successful. We think we get about three times the productivity in our technology development by having it focused towards design. We also find the designers are able to assess the use of technology versus innovative design practices. This approach is analogous to the development of the gas turbine engine, where we could have taken forever to develop new materials (say carbon-carbon) for turbine blades on the one hand or we could take the 'low tech' but really innovative design approach, of using turbine blade film cooling. Good design will often reduce the need for exotic technology.

**National Aero-Space Plane Program Schedule**



ECR = Engine Concept Review
ACR = Aircraft Concept Review
TMR = Test Module Review
ADR = Aircraft Design Review

What we know is that there is a balance between technology and design and we have to juggle that balance depending on many different factors. We're providing the technologists with the focus that they need to produce a product for the design community, but within disciplined schedules. The offsetting factor is that the program is fundamentally run by a desire to achieve the technology advances on a milestone basis, that is, we're not arbitrarily driven by either schedule or funding, we're driven by accomplishment of our technical milestones. And what you see in the Phase 2 schedule are all components that lead up to a critical Phase 3 decision to decide to go ahead and build two of these experimental vehicles.

There are many other areas that have been achieved in the X-30 technology development, many of which I'm not able to discuss in open forum. There are about three thousand people involved in this program in the country today, all with the necessary needs to know. It is a normal secret level program and there are no special access classifications involved.

I would like to give you just a couple of comments about the program status at this point. This year, in the President's budget, we asked for $320 million, we received $254 million; that's about a 20 percent reduction in our request.

I find that this is due largely to the pressures and priorities that were placed on the defense budget, and that while we don't like it within the program, it's a necessary adjustment in view of the overall pressures and priorities on the DOD budget.

There is some question as to whether a major science and technology program, such as the X-30, can sustain in this environment., At the present time however, the outlook is positive. We need to keep producing technically, keep showing progress, maintain our goals, and I believe we will get there.

We have had nine months scheduled extension to the program due to the funding hits so the program now is primarily budget driven, as opposed to technology driven. Although the materials technology development lead time is tight, we think we can make it within the schedule that we have laid out, including scale-up for large components.

**The potential of NASP for truly low cost space flight remains outstanding.**

We are changing our program management. The program will be transitioning from DARPA, who initiated the program in 1984 under my leadership, into the Air Force. The new program manager is Dr. Robert Barthelemy, former technical director of AFWAL, who is already in place at the Joint Program Office in Dayton, Ohio. I want to emphasize that this continues to be a joint program. The management office has deputies and technical personnel from NASA and the Navy in the 70-man group that runs the program on a day-to-day basis.

In summary, highly significant progress has been made to this program during the past year. We are adhering to our program goals. The potential of NASP for truly low cost space flight remains outstanding. It's a tough challenge with significant technical risks, but we have a growing conviction that the X-30 will prove for all time that "the sky is no longer the limit."

Thank you very much.

**DR. BYERLY:** Thank you very much, Bob. Thank you very much, Jim and Bob, for a very nice presentation.

# EAST-WEST LAUNCH COMPETITION

*Moderator:*
**Craig Covault,** Senior Space Technology Editor; Aviation Week & Space Technology

*Speakers:*
**Deke Slayton,** Astronaut and President, Space Services, Inc., of America
**William B. Wirin**, Vice President, Space Commerce Corp.
**Doug Heydon**, Executive Vice President, Arianespace, Inc.
**Richard Brackeen,** President, Martin Marietta Commercial Titan, Inc.
**Louie Raburn**, Senior Director, General Manager, Delta/Delta II Programs, McDonnell Douglas

*CRAIG P. COVAULT is the Senior Space Editor of Aviation Week and Space Technology. He has been affiliated with the publication as Space Editor since 1972. Mr. Covault has authored about 600 articles on U.S. and Soviet Space programs including some 300 stories specifically on the space shuttle. He has also written for Omni Magazine, Science 81, and World Book Encyclopedia. He has routinely flown simulations with U.S. astronauts in their spacecraft trainers and has donned pressurized space suits for underwater demonstrations of large space structure assemblies and space telescope servicing. Several of his articles promoted the execution of the Solar Maximum satellite repair mission, the Palapa/Westar retrieval mission and the first spacecraft intercept of a comet. Mr. Covault has flown numerous high performance aircraft for Aviation Week including the VSTOl Harrier,F-111, F-106 and the F-4. He holds a journalism degree from Bowling Green State University. Grants from Readers Digest Magazine enabled him to begin writing at the Johnson and Kennedy Space Centers while still in college.*

**MR. MACLEOD:** Without a long introduction, I have sometimes referred to this gentleman, if he's quoted the way he is, as one of the apostles because he writes for the Bible. The Senior Space and Technology Editor for "Aviation Week and Space Technology," Craig Covault.

**MR. COVAULT:** Thank you, Dick. The line I always use is that I make all that stuff up.

I'm the lucky moderator this week, because while a lot of the other panels talked about how everything has gone to hell in a handbag, I drew the real upbeat assignment. It's all good news in the unmanned booster world, and these guys you are about to hear have a lot to tell you, because they've really been moving out.

The topic, as you see on your paper this morning, is launch competition between the East and West. Forgive us if we digress a little bit. We've got such a diverse panel, that with so much that's happened in the last few years we'll cover perhaps more territory, than just the East/West competition.

When I first joined "Av Week" about 15 years ago, things were pretty basic in ELVs. DOD and NASA ran their missions with the same launch vehicle, stable and commercial payloads were always accepted as reimbursables. Then shuttle fever hit. ELV lines started to taper off, and some other things started to happen as well, even before the Challenger accident.

The Soviets put the moves on INMARSAT to launch on a proton. That, in effect, was the first move for Soviets for a non-Soviet payload. Some gutsy guys like Deke Slayton and Dave Hannah got Space Services spooled up to try to offer commercial launch services. At the Air Force, Pete Aldridge saw the need for a much broader ELV base, and started the Titan IV program, then called the Complementary Expendable Launch Vehicle (CELV), and Ariane IV got off to a very good start as well.

That's all fairly simplistic, but the point is a lot was underway quite a few months before the Challenger accident. Then the accident hit. I don't have to tell you what effect that had. Of course, we also had ELV accidents about a year and a half or so before Challenger. An Atlas Centaur was lost when its Centaur sprung a leak. Two Titan IIIs were then lost. Two Arianes were lost, a Delta was lost and then another Atlas Centaur was lost to lightning at the Cape.

And after all that, there's been a lot of relandscaping taking place.

The current situation is a lot brighter. Just a quick summary; Ariane resumed flights, two successful missions in '87, one so far in '88, and about seven more flights to go this year. The Titan IV program is cranking out 23 boosters for the USAF, and that's expected to go to upwards of 50, and Martin also started the Titan III marketing in a very big way with important orders coming in for commercial payloads.

General Dynamics has announced plans for 18 Atlas Centaurs for commercial launches, as the key competitor against McDonnell Douglas in the Block-2 MLV program.

The Delta II program at McDonnell Douglas is gearing up for a launch late this year. The new Delta IIs will carry NAVSTARS, and certainly the Soviets are aggressively marketing the proton, and smaller vehicles at token prices compared to what the U.S. and the Europeans can offer.

On top of all that, the Chinese have developed the Long March III, which equates to a Titan II with a mini Centaur on top. I have seen it in China three times, it's a great little launch vehicle. It does a great job. They have launched it four times, three times operationally with a hundred percent success on the operational missions, and about a 95 percent on their first R&D mission.

The Chinese are also offering cut-rate prices.

Among the basic issues that we would like to discuss today are the effects of this Chinese/Soviet marketing on the U.S. and the Ariane launch operations, and the outlook into the mid- 1990s for commercial launch options. Has the launch backlog that we've all heard about as a result of the shuttle accident largely disappeared?

On our panel, we have the top people in the world to discuss one of the most exciting businesses in the world. We have a representative from Space Commerce Corp. who is marketing the proton; Arianespace with the Ariane; Space Services, Incorporated for small Conestoga boosters, and Martin Marietta and McDonnell Douglas.

We would like each of the panelists to spend about five minutes to summarize these current programs so we have time for some Q & A. Then we'll get the discussion off with some questions.

I would like to open the discussion today with a presentation from Deke Slayton from Space Services, Inc. Deke is really not involved in the East/West launch competition in the same sense that the Ariane guys and the Martin guys are, but he's certainly out there marketing to the small satellite people around the world.

I don't think I have to tell you, Deke was one of the original seven astronauts in 1959; flew Apollo-Soyuz in 1975; headed the space shuttle approach and landing program now ten years ago; was Director of the Orbital Flight Test program in NASA, then after 23 years at NASA left to form Space Services, and now has been there something going on six years.

So Deke, I will let you start off.

*DR. DONALD K. "DEKE" SLAYTON hold a B.S. in Aeronautical Engineering from the University of Minnesota, a honorary doctorate in Science from Carthage College and an honorary degree in Engineering from Michigan Technological University. A WWII pilot, "Deke" instructed in B-25 and A26 aircraft. He has more than 8,000 hours of flying time; 5,000 in jet aircraft. He was named one of the Mercury astronauts in 1959. In 1972 he was Apollo Docking Module Pilot of the Apollo-Soyuz mission, and as manager of the Space Shuttle Approach and Landing Test, he conducted a series of critical Orbiter flight tests, resulting in verification of Orbiter's subsonic performance characteristics and verification of 747's capability to ferry the shuttle. He currently is involved in the following activities: President and Vice Chairman, Space Services Incorporated of America; Chairman, Space America Incorporated; President, International Formula One Pylon Air Races; Member, Department of Transportation Commercial Space Advisory Committee; Consultant, Aerospace Corporations; Director, Columbia Astronautics.*

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**MR. SLAYTON:** Thank you, Craig. I really came back here this year to collect all that scotch I won from my bets last year and haven't had much success so far.

I don't have a lot of time, and most of you, I think, are familiar with our company, but I want to just set the stage, and tell you what we are selling and then who we're trying to sell it to.

Our company started back in '80; we did a test launch in '82; we have a family of small expendables, and we have some contracts and agreements for launch sites. We have financial backing, which is one of the biggest problems, particularly for a small company, and we have a lot of proposals out. Actually, we have about 104 launch proposals as of today, for the next four years.

What we're selling are turnkey launch services. We're not interested particularly in selling hardware, although we're not allergic to that, but what we would like to offer people is a fixed price which includes everything, and that gets around the problem of buying a car-type concept where you get a list of $6699, or whatever, and it takes you $10,000 before you got the wheels on to get it out of the door. What we're quoting you is what it's going to cost you to get into orbit.

Next, we have a family of vehicles ranging from about 400 pounds to low earth orbit, up to 4,000, and we match to satisfy our customers within that range. We can put about 600 lbs. into GEO with our big vehicle. To put it into perspective, our biggest vehicle is about a third of a Delta. Our concept is to use well-proven components. We have relied heavily on the Delta in that we use castor motors, and a lot of the interstage stuff that's been developed by Delta. That's basically the concept we've used down the line. We don't want to go out and reinvent the wheel; we just want to sell a very reliable product based on proven components.

The markets we're looking at are five, and in all cases, we're dealing with both a commercial element of it and a government element. In all cases, they also are all international in nature. The proposals we have out are probably at least 50 percent international. That's one reason we're not worrying about East/West competition. We think we're going to get our share of the non-U.S. business.

For positioning or navigation, the same thing applies. Again, we're dealing in small satellites. Your host at the luncheon today, Starfind, has a small positioning satellite, a very unique system, and we have an agreement with them to provide them launch services for that.

Remote sensing is a system that's been around for a long time, in the form of LANDSAT. We don't think LANDSAT will ever be a commercial business. It costs too much to put it up, but we think there can be commercial systems put up that would be relatively small and cheap, and again the applications for that are fairly well known, both government and commercial.

Next is micro-gravity. Most people don't think of micro-gravity as being an expendable launch vehicle business; but as a matter of fact there are a large number of micro-gravity payloads out there today. There are already a couple satellite systems that exist to recover payloads from orbits, basically a small Mercury, if you will, and we are dealing with people on that application, and of course on the government side, a lot of that is research. That spans the markets we're dealing in. They're all small payloads. Some may grow to be bigger ones, and when they do, we'll be delighted to turn them over to our big brothers, who you're going to hear from next.

Thank you.

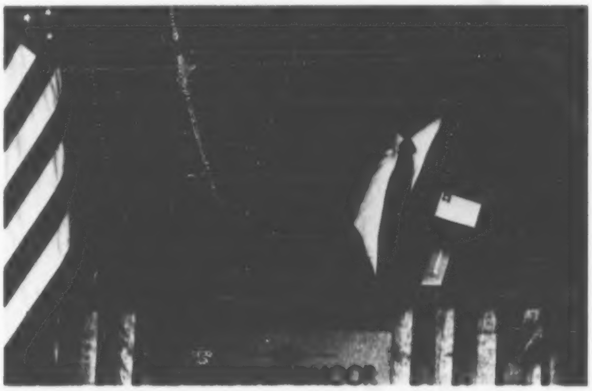
**MR. COVAULT:** Our next speaker represents a change to the program. You have Art Dula on your program for Space Commerce to talk about the marketing of the Soviet proton. But Mr. and Mrs. Dula are having a baby today, so we have instead of the President of Space Commerce Corp, the Vice-President of Space Commerce Corp, Bill Wirin, who may be familiar to some of you, as he retired out of here as an Air Force Colonel not too long ago. What's an Air Force Colonel doing marketing the Soviet proton? They'll haul him off when he's done.

Between August 1985 and August 1987, Bill Wirin was Air Force Space Command's competition advocate, and I think that's where he'll tell you he's coming from, relative to getting in bed with the Soviet Union on selling a major rocket system; the competitive aspect of that is what's drawn him in.

Bill taught space law and policy at graduate level for the University of Colorado, Colorado Springs and Webster University.

He was the initial Command Director of Innovation for Space Command, caused some good ideas to be adopted by convincing senior staff to implement them. He was also Space Command's Judge Advocate between August 1982 and August 1985, and he was also AlaskaAir Command Staff Judge Advocate. It's interesting to see — I've just returned from Alaska flying with AlaskaAir Command — someone who has been up there as well.

So let's introduce Bill Wirin, for the Space Commerce Corp., and the marketing of the Russian proton.



*PROFESSOR WILLIAM B. WIRIN was Command Competition Advocate for the U.S. Air Force Command at Peterson AFB, Colorado. His task was to eliminate unwarranted noncompetitive purchases; and to use the competitive pressures of the open marketplace to find the best technical solution, and to get the needed products and services at a fair and reasonable price. He earned a B.A. in political science from Occidental College, and his Juris Doctor from the University of Southern California School of Law. He was admitted to the Supreme Court of the United States; United States Court of Appeals; Supreme Court, State of California; and the Federal District Court for the Southern District of California. Professor Wirin is currently a Professor at Webster University.*

**MR. WIRIN:** Thank you very much. I am pleased to be here this afternoon. Ladies and gentlemen, very distinguished guests, I welcome the opportunity to talk a little bit about the Space Commerce Corporation. Clearly, as a retired Air Force officer, I do not want it to get around that I'm "representing a foreign government." There's a law against that and some lawyer might decide to prosecute me. But the long and the short of it is this: The proton needs no marketing. All it needs is a release by the State Department, and a launch license to permit U.S. payloads to go aboard.

We've heard for years that the Soviet Union is closed. What better way to get into the Soviet Union than to trade with them? If we really are looking to try to change them, to bring them into the 20th Century, to have them understand us a little better; maybe for us to understand them a little better; now is the time. They have now opened up Tyuratam, the launch complex, to Americans, to accompany a satellite; if you will, to stay with that satellite during the entire period of time that it's in the Soviet Union, so that it is never out of U.S. control. The only technology transfer would be that limited amount to the Soviets, to enable them to mate the satellite with the proton booster.

**What better way to get into the Soviet Union than to trade with them?**

The State Department also complains that there is predatory pricing. I think those problems can be resolved. I don't think they're the crucial element. I believe that the proton launcher fills a place in the market which the other launch companies don't at this period of time. Therefore, we ought to avail ourselves of that capability, or else we may find that our satellite industry is walking overseas.

I'm reminded somewhat of the story of the boy who owned a baseball and was asked to let the team play with his ball, but when they would not let him play, he refused to let them have the ball and they went on without him.

I would suggest to you that there are other nations in this world that could build satellites. If American satellites are not used, and do not have the capability of going aboard the Soviet proton booster, then other nations will produce satellites and they will go aboard the proton. Then we will have a situation where they will sell just the services back to this country, because the State Department cannot prohibit the sale of services. They may be able to prohibit the launch, but not the ultimate economic consequences.

Essentially what I'm saying is a two-fold message. Competition is good for us, and good for them. It opens the doors to the Soviet Union. It may enable them to learn a little bit more about us, but, more importantly, we may be protecting some very vital industries in this country. If we do not take those steps, others will, and then we'll wonder why we are second best.

**Competition is good for us, and good for them. It opens the doors to the Soviet Union.**

I look forward to your questions. Thank you.

**MR. COVAULT:** The Ariane is certainly the most significant competitor to the U.S. launch operations in the commercial sector. Our speaker today for Ariane is Doug Heydon, who is the President of the U.S. subsidiary of Arianespace, responsible for marketing and sales in the U.S. Doug has been with Arianespace about four years, and he recently became President of Arianespace after joining it as Executive Vice-President.

Prior to this, Doug was Director of Marketing for the Space Program at the Convair Division of General Dynamics. And about sixteen years prior to that, Doug was heavily involved with TRW in various positions. Doug?

**MR. HEYDON:** I'm going to depart a little bit from the standard tradition here too, and not use any viewgraphs for two reasons. One is, I recently contributed an article to "Spacewatch" at the suggestion of the Space Foundation in response to a February article by Art Dula on the subject which Mr. Wirin just spoke on, and I made several points in that article which I think are fundamental to this whole subject. I think the questions that need to be asked with regard to the East/West competition are only two. First is it fair, and secondly is it smart?

I think under the present ground rules that were alluded to in some of the earlier talks this morning, particularly Courtney Stadd's, there is a very significant element of imbalance in an international trade sense. While it's true that international competition can be healthy, and we think that the situation that exists between Arianespace and our U.S. competitors certainly demonstrates that, it's essential that this competition be conducted on an equitable and fair basis.

There has been a lot of talk over the past years about level playing fields and that sort of thing, and most of it was directed at us, because at that time it appeared to many people that Arianespace had an unfair advantage. I think as the dust has settled from the initial consultations, which is the official term that's been applied to discussions between the U.S. government and the ESA representatives, representing the several European governments involved in the Ariane program, it has become clear that, in fact, the playing field between the U.S. and Europe is indeed fairly level already.

**While it's true that international competition can be healthy...it's essential that this competition be conducted on an equitable and fair basis.**

*DOUGLAS A. HEYDON is president of Arianespace, Inc., the U.S. subsidiary of Arianespace, responsible for marketing and sales of Ariane launch services in the U.S. He advanced to this position in November, 1985 after having served as Executive Vice President and General Manager since joining Arianespace in June, 1984. Prior to this Heydon was Director of Marketing for Space Programs at the Convair Division of General Dynamics for three years. During his earlier career, Mr. Heydon has held a wide variety of engineering and management positions with Sperry Gyroscope Company, TRW Systems and its predecessor Space Technology Laboratories, and Transco Products. In addition he co-founded and operated a small quartz crystal filter company, Filter Technology Incorporated, based in Carlsbad, California. Heydon received his Bachelor of Aeronautical Engineering degree in 1951 from Rensselaer Polytechnic Institute and his M.S. (A.E.) in 1960 from Stanford University. He has served as an electronic technician in the U.S. Navy and as a research and development officer in the U.S. Air Force Reserve.*

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What is on the agenda for the near future? For those of you who may not be aware, it is a transition, a probable transition from consultations to negotiations, leading to these "rules of the road" or level playing field ground rules, however you choose to categorize it, between the western democracies.

There is no similar set of conditions being contemplated between the western democracies and the other economic systems in the world. The two that we're principally concerned with in this conversation, of course, are the Soviet Union and the PRC. Until such time as we are really working in a similar set of business ground rules, where we have to try to make a profit and meet shareholders' requirements and the like, we are really talking about two very disparate systems. So as far as the fairness issue is concerned, it's a trade issue, pure and simple. Technology transfer certainly enters into the near-term considerations, but it will not forever remain one.

The other aspect, does it make good sense as a good business, I think, has to be considered from a much longer range view.

The fact is almost indisputable that given the opportunity for the kinds of pricing that the Soviets and the Chinese are offering, a fraction, either a small fraction or a reasonable fraction, but a fraction nonetheless of the prices that both the U.S. ELV manufacturers and we are required to charge to cover our costs, that there is certainly an attraction in the near-term view of those prices.

The best leading example today is the AUSSAT competition. Those of us who are involved with it know how enamored the Australian AUSSAT organization has become with the Chinese Long March pricing. I'm happy to say that I think one of the many places where we and our U.S. competitors are shoulder to shoulder on this issue is that we have refused to provide a back-up capability to the Long March simply because it's stupid business for us to do so. Why should we help the competitors come in at cut rate prices when they have not yet demonstrated the capability to satisfy the AUSSAT organization that they could do the whole job.

I think the issue of long-term stability and long-term business comes right down in the final analysis, to one of retention of control and alternatives. There's no question in my mind that given a free entry to the western market by the Soviet and Chinese systems, that the western systems will very soon find themselves unable to compete and to stay in business. I won't go so far as to say that all of us would simply go out of business, but it certainly is not a far-fetched alternative.

Then the question arises, are we, the western world, ready to put all of the control of launch systems and possibly the satellite systems in the hands of the other folks? This may sound like an alarmist position, but it's also a very realistic business position. I think those of us who have established the present situation need to continue to recover and develop the stable business environment that is required for continued reliable access to space.

We won't be able to do it unless there is an even-handed business environment, and I think that's the fundamental issue that we're dealing with in this arena. I know my sometimes competitor and colleague, Dick Brackeen, has some very interesting points to make in this regard, and I'm pleased to say that his arguments follow very closely on those which I had in my article last month. So I too look forward to the question and answer session which is the real meat of this kind of thing. I hope you have some good questions coming up in a few minutes. Thank you.

**MR. COVAULT:** Thank you, Doug.

The Titan program has certainly had a busy two years, with the accident, shortly after the Challenger, and then an exhaustive program to thoroughly look at what could be done to the Titan to increase its reliability for the next 20 years. And I think that's been done very effectively, as you will hear from the next guest, Dick Brackeen, who's President of Martin Marietta Commercial Titan Company, formed in 1987 to commercially market the Titan vehicle.

Dick's organization focuses on commercial sales of a modified version of the highly successful Titan 3. His responsibilities include marketing, contracting, and launching commercial payloads on the Titan.

Prior to taking his current position, Dick was Vice-President of Space Launch Systems at Martin Marietta Denver Aerospace, which became Martin Marietta Astronautics Group in July of '87.

Dick joined Martin Marietta in 1967 as a development program manager in the firm's Orlando operation. In 1969, he became project engineer for flight technology on the space shuttle program.

From '72 to '74, he was Director for both the shuttle booster, and Martin X-24B Program.

His responsibilities included the development of the shuttle solid rocket booster parachute recovery system, and management of the X-24 flight research vehicle, a lifting body, and one of the finest X-airplanes the United States ever produced. Dick. . .

**MR. BRACKEEN:** Thank you. I'm pleased to be here today, and what those of you who know me will judge as uncharacteristic, I will not describe the Titan launch vehicle program. I'm going to stick to the issue that the agenda set, and that is East/West launch competition. I have some viewgraphs, which I think you'll find interesting because they address, "Is there a backlog?" And "How many launches a year will there be?"

Courtney Stadd did an excellent job this morning, I think, in giving you the background of this evolutionary process and the birth of the commercial launch industry.

Birth of the U.S. Commercial Launch Industry

Shuttle and Ariane were sufficient to meet world demand
  - Competition between two government launch programs
  - Launch prices based on government formulas

Competitive landscape changed by Shuttle and Ariane setbacks
  - Near-term backlog resulted from failures

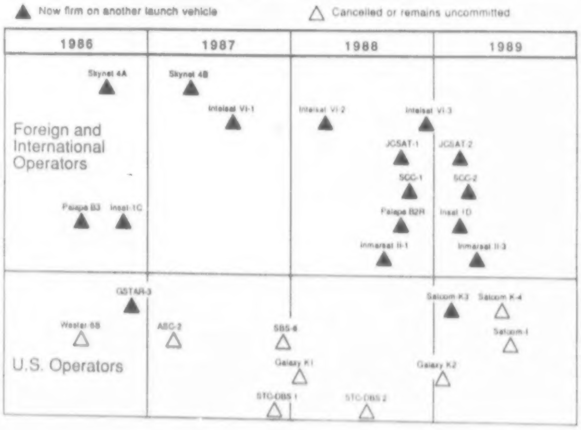
Shuttle removed from commercial launch role
  - Explicit U.S. Government policy decision to create private launch industry
  - Shuttle reserved for missions that require its unique capabilities

I want to use this first chart to emphasize that the shuttle and Ariane were quite sufficient to meet world demand and would be today, as well. The thing that I believe we'll all recall is that launch prices were based on government formulas and they could be again.

I have taken three charts out of what we update quarterly as a commercial market survey, just to share with you our views of the future commercial launch market. I'm going to start with the shuttle manifest, and those satellites to be launched on the shuttle that are classified as commercial to show you what has happened since the policy changed.

*RICHARD E. BRACKEEN is president of Martin Marietta Commercial Titan, Inc., formed in April 1987 to commercially market the Titan space launch vehicle. Prior to taking his current position, Brackeen was vice president of the space launch systems division at Martin Marietta Denver Aerospace, which became Martin Marietta Astronautics Group on July 1, 1987. Brackeen joined Martin Marietta in 1967 as a development program manager in the firm's Orlando operation and moved to Denver Aerospace in 1968. In 1969, he became project engineer for flight technology on the Space Shuttle program.*

Pre-Challenger Shuttle Customers

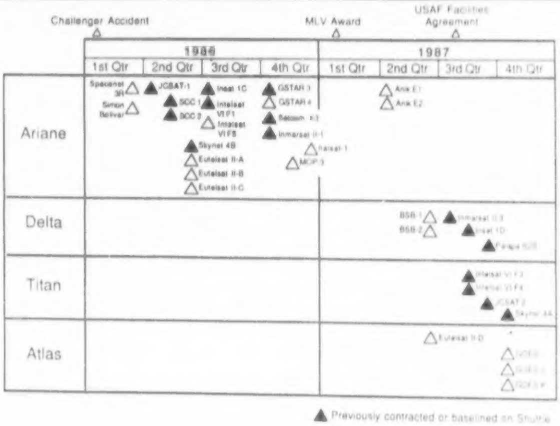


All the solid symbols are people who have made a decision to get into space since the policy has changed, and they cannot be launched by the shuttle. It's interesting, I think, to us as a company, and perhaps to you as an audience, to note that the foreign and international operators all have already made other launch arrangements.

Many of the U.S. domestic programs that were planned for shuttle had their reservations or deposits in, are not now planning to go into space on an ELV or by any other means. Many of them have deferred that decision. It may mean that the international and commercial demand projections were firmer than some of these U.S. business plans.

This next one is a very interesting chart because it shows all of the commercial satellite launch orders that have happened since the policy changed.

Post-Challenger Orders for Launch Services



All the ELVs are shown there — Ariane, Delta, Titan and the Atlas — all of whom have, of course, booked some commercial launch orders. You might look across the top of the graph and find that Ariane got about 60 or 65 percent of those orders before any U.S. ELV operator was even licensed to offer a firm price. Unfortunately, while we were all getting our government policy and private industry investment acts together, the existing commercial ELV Ariane did an effective job of booking most of the backlog. That's not to say that the U.S. ELVs have not been successful, which as you can see, they have. With perhaps one exception, there have been no firm Ariane orders since American ELV alternatives existed.

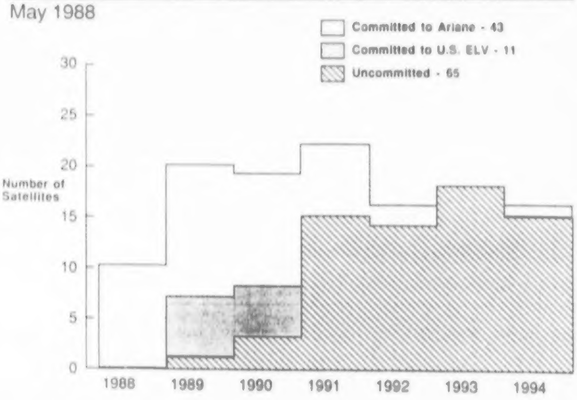
As for Titan, I can say that during the period of time we sought an agreement with the government under which we could reimburse them for use of their launch pad, we also spent determining the amount of our investment. We needed a new faring to accommodate the largest commercial satellites designed for the shuttle; we needed to develop and test a new dual payload carrier; we needed to modify the pad for our new commercial launch vehicle so that it could accommodate dual payload launches; and that investment is just about $100 million for us.

I read in the press that comparable investments have been made by the other U.S. ELV manufacturers so you can see it was a momentous year for us.

What you see now is a summary chart out of our market analysis of the future, so we can see if there truly is a need and justification for more ELVs. This is the conservative, verifiable future projection for commercial launches. So we don't get tangled up with nomenclature, let me add that when we speak of commercial satellite launches, we are speaking only of the large, long-lived revenue generating telecommunications, broadcast and other such satellites. We are not speaking of development and experimental programs for materials processing, or other developmental launches. This is a purely commercial communication satellite marketplace.

Projected Commercial Launch Service Requirements

May 1988



The un-shaded area is, of course, those satellites already committed to Ariane; the majority of the near-term launches are those commercial operators who have committed to a U.S. ELV of one kind or another; and the striped are those who have yet to commit. Let me simply say that that bow wave of pent-up demand has receded rapidly into the future, and it's my belief that every U.S. ELV launch service operator has unused launch opportunities right now.

**McDonnell Douglas, Martin Marietta and General Dynamics, ...have all made major financial commitments and have entered the market.**

Well, with that overview of the market and what has happened to the pent-up demand, let me now turn to the issue that I was asked to talk about.

What is the current competitive environment? Well, McDonnell Douglas, Martin Marietta and General Dynamics, as Courtney Stadd said this morning, have all

### Current Competitive Environment

**Martin Marietta, McDonnell Douglas, and General Dynamics established in launch services market**
- Each company has committed resources and taken risks
- Each company has won commercial business

**Significant American launch capacity is planned**

| | |
|---|---|
| • Titan III | Up to 5 dual launches per year |
| • Atlas / Centaur | Up to 8 dedicated launches per year |
| • Delta II | Up to 12 dedicated launches per year |

- Uncommitted launch slots remain open in 1989-1990

**Competition among existing providers of launch services is already intense and will increase in intensity**
- Arianespace remains market incumbant and price leader
- Japan will probably be competitor by mid-1990s
- Supply will exceed demand in early 1990s

made major financial commitments and have entered the market. Each company has booked either three, four, or five commercial launches and significant commercial launch capacity still exists in the near term. With Titan III, we have programmed in our lot buys and in our launch operations planning, up to five dual satellite launches a year, if we should be so fortunate as to be granted that many by the market. Atlas Centaur has announced they could do up to 8 launches a year. Delta II, up to twelve flights a year, and those are dedicated. Our five duals equal ten satellites, and so you can see there are thirty satellite launch opportunities per year, represented just by the American ELV fleet. And I haven't yet mentioned Ariane, which has announced up to nine launches per year, all of which could be dual.

If you recall the prior chart, in no year where we can project, does there appear to be a desire for more than 20 to 22 satellites launched. So all of us are faced with a difficult situation of surplus launch capacity.

Competition among the U.S. ELV providers and the Ariane is quite fierce, as we'd all tell you. We do believe Ariane is possibly the market leader. They have the major market share. They're a tough competitor, and they will usually be the price leader. We expect the Japanese, who also have a free market economy and an interest, might enter the market in the mid- '90s, and we expect the supply to continue to exceed demand all the way through the '90s. Those of you who think about the MLV 2, that vehicle also fits within this demand schedule. It will simply be another launch vehicle that addresses this smaller supply of commercial satellites.

I couldn't speak without using this next chart, because you need to understand how we in the U.S. view this aspect of Eastern competition. Once again, we see it as a competition between governments and private companies.

If you will go back in history a few years, you will see that none of our companies found a way to successfully compete with even our own government for launching commercial satellites into space. Absence of the profit requirement, absence of economic return on investment and initiatives to price to sell irrespective of costs recovered, are just a problem we can't deal with.

### Aspects of Soviet and Chinese ELV "Competition"

**Unfair financial advantages over Western operators**
- Government programs vs. privately financed corporations
- Ability to price to sell regardless of cost
- Hard currency needs and political factors outweigh profit motive
- Programs do not compete for labor and resources in free market

**Absence of reciprocal market access**
- Want access to Western markets while maintaining domestic monopoly

**Technology transfer is a problem**
- LV operator always has some access to satellite
- Communication satellite technology is valuable national asset

**Free world market cannot support more than 3 or 4 competitors**
- Shaking out of launch operators likely even at free-market prices

Let me just say, if you want to talk about fairness, there is no reciprocity even offered. There's yet to be a hint of an offer to launch Chinese and Soviet satellites on Deltas, Titans or Atlas Centaurs, nor do I expect there to be.

And my bottom paragraph on that slide tells you that we already expected a consolidation of the market, a shake-out to occur in the early '90s, even without government competition at non-economic prices.

I want to speak plainly, because this is an important issue. I ask your leave not to see this as just a threat; it's a very serious deterrent for me and for my company. If Chinese and Soviet launch vehicles enter the mature, large telecommunications satellite market, we expect Arianespace to price down to their prices. Let me remind you that when the U.S. government provided launches of commercial satellites, the European consortium priced down to the shuttle prices. That would just about take care of the ability of a private ROI-oriented U.S. supplier to stay in the market.

### Market Impact of Chinese and / or Soviet Entry

**Chinese / Soviet entry will force private U.S. launch companies out of market**
- Arianespace will price down to foreign government price level (Ariane vs. Shuttle situation in early-mid 1980s)
- Private U.S. firms, unable to compete, will redeploy assets

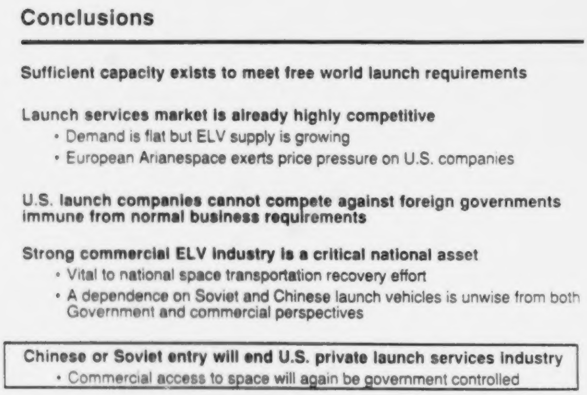
Final Result
**Satellite operators will have access to launch capabilities that represe**
- Lower prices but fewer options
- Foreign government-managed programs only
- Lower reliability than U.S. ELVs
- No U.S. commercial launch alternatives

We would all continue to make ELVs for government programs which bought them on government contracts and paid for them in advance. But as you have now witnessed over the last couple years, when we had a space transportation crisis, providing an alternative is not a process that can be turned on instantly.

**A strong, commercial ELV adjunct to our national government programs, we think, is wise for America. It's vital to the national space transportation recovery effort, and it's a critical national asset.**

The final result would be a general reduction of launch prices, probably back to the shuttle commercial satellite pricing range. Only foreign government managed programs would be available for commercial payloads, I believe. And their vehicles were generally lower reliability than our Deltas, Atlas, and Titans and; most importantly, I don't believe there would be a U.S. privately financed fleet of commercial ELVs.

On my last chart, I simply want to emphasize sufficient capacity exists, and unfortunately it's overcapacity at this time. The launch service market is very competitive already. Many of us are finding more competition than we had anticipated. U.S. private launch companies cannot compete against governments.



Conclusions

**Sufficient capacity exists to meet free world launch requirements**

**Launch services market is already highly competitive**
- Demand is flat but ELV supply is growing
- European Arianespace exerts price pressure on U.S. companies

**U.S. launch companies cannot compete against foreign governments immune from normal business requirements**

**Strong commercial ELV industry is a critical national asset**
- Vital to national space transportation recovery effort
- A dependence on Soviet and Chinese launch vehicles is unwise from both Government and commercial perspectives

**Chinese or Soviet entry will end U.S. private launch services industry**
- Commercial access to space will again be government controlled

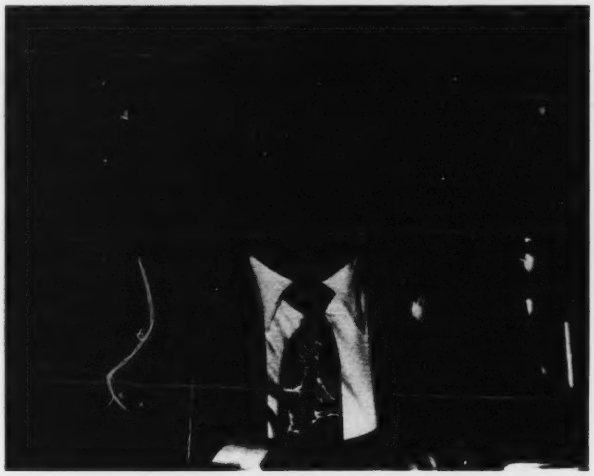
A strong, commercial ELV adjunct to our national government programs, we think, is wise for America. It's vital to the national space transportation recovery effort, and it's a critical national asset.

Any government policy decision that would, in the long term, as Doug Heydon said correctly, result in our dependence on the goodwill of the Soviets or the Chinese to continue launching commercial telecommunication satellites would, we think, be unwise.

I now look forward to your questions. Thank you.

**MR. COVAULT:** The Delta booster has been on the scene for the better part of 30 years. We have to talk about the new Delta today, Louie Raburn, who is essentially the father of the vehicle. Louie is now Senior Director, General Manager of Delta Programs Astronautics in Huntington Beach and over the course of 30 years, Louie has held many program and engineering assignments within McDonnell Douglas. He participated in the initial design of the Delta, as I said, and he was present for the first launch in 1960. He's now involved in the Delta II program which he's going to tell you a little bit about; then when we're finished with that, we'll move on and have some questions.

**MR. RABURN:** Thank you, Craig. I'm in one of these unenviable positions that sometimes occurs. I epitomize, though, one of the comments that was made by our distinguished initial panel yesterday. I was drafted at lunchtime today, and I was able to say "Well, we have viewgraphs, and we'll try it."



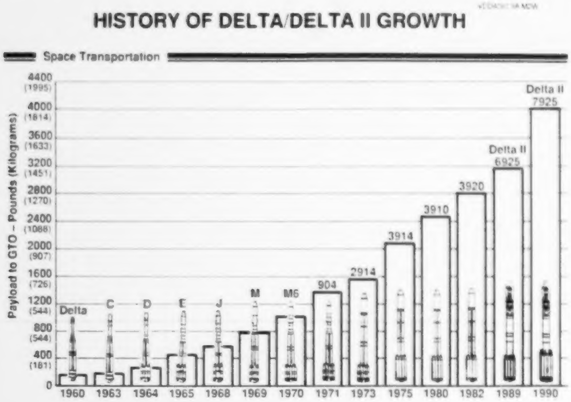
*LOUIS C. RABURN was appointed Senior Director-General Manager, Delta/Delta II programs in February 1987. These programs involve development of an improved version of the Delta launch vehicle for use by the Air Force and NASA, and implementing commercialization of the Delta vehicles. Mr. Raburn received a B.S. degree in Industrial Engineering from Oklahoma State University and completed two years of graduate studies. On completion of his degree work at Oklahoma State, he was a test engineer at the Oklahoma Power and Propulsion Laboratory and an instructor in the School of Civil Engineering. He joined the Douglas Company-Tulsa Division in 1955, progressing to Assistant Director of Engineering prior to joining the Missile and Space Systems Division in 1965. Under the leadership of Mr. Raburn, the Strategic Defense Initiative Office designated the Delta team to design and develop new propulsion and guidance hardware and integrate the most complex mission attempted in space to date. Mr. Raburn has received an Outstanding Achievement award from the Air Force Systems Command and Group Achievement awards from NASA. He was nominated by the editors of "Aviation Week & Space Technology" for his contribution to aerospace in 1986.*

So, I will spend a few minutes talking about the Delta II program, and the Delta program in general as it developed over the years. I would like to make one comment about Gen. Phillips' statement about the lack of activity in the launch vehicle area, since the accidents involving Challenger, Titan, and the Delta Vehicles.

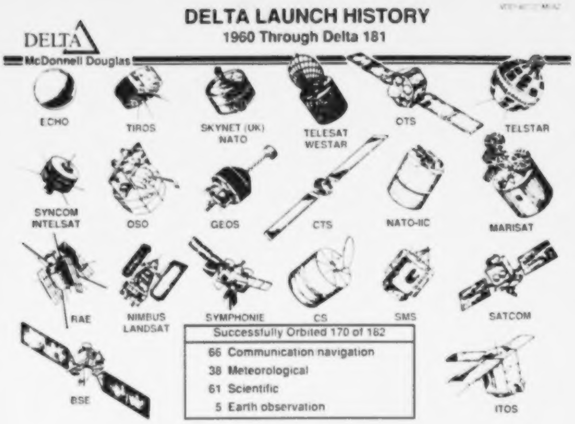
After the loss of Delta in '86, we were able to turn

around the Delta program and launch one of the most complex missions that's ever been launched in this country four months later. Since that time, we've launched a weather satellite, a communication satellite, and another very complex SDI program 181. So, we do have a very durable and versatile vehicle and this is the outgrowth of the policy we've pursued many years, in adopting proven techniques and technology to grow the Delta vehicle.

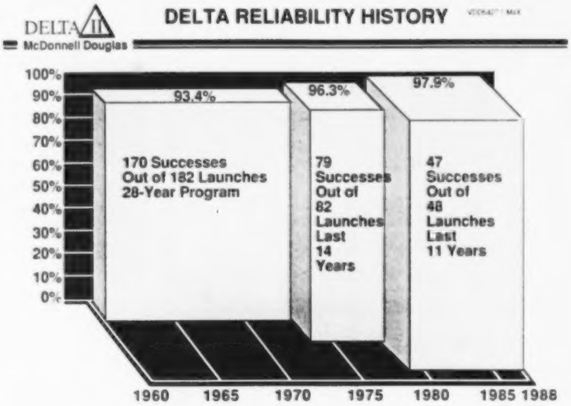
This next chart gives you a view of how that's been accomplished over the last 25 to 30 years. We launched the Echo balloon, one of the early communication experiments, in May of 1960. And our current projected capability with the Delta II vehicle is over four thousand pounds. The Echo was about a hundred pounds, or, I should say the equivalent of a hundred pounds into GEO-SYNC transfer, which this chart represents.



And this chart represents the versatility of the Delta vehicle. That this history has encompassed many, many different kinds of satellites, with communications certainly being the largest area, and our familiarity with that part of the industry is certainly shown by the number of launches that we've made of communication satellites. Meteorological, scientific and earth observation fill out the 180-some-odd launches that we've made to-date.

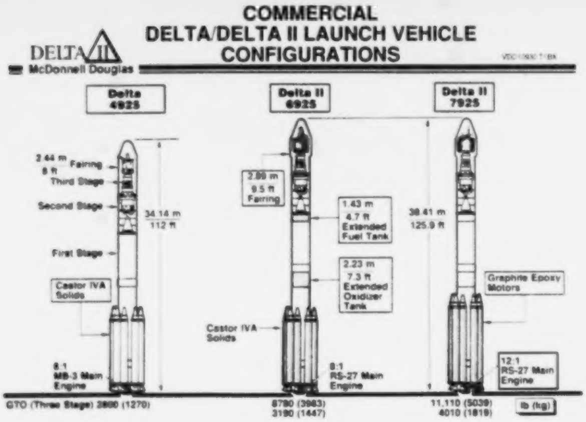


I think one of the primary facets of the Delta program that is going to keep it a competitive vehicle, is the fact that we have been able to, while sustaining this kind of growth, compile what we think is an enviable reliability record. That chart shows of all of the 182 launches we've made on the Delta vehicle, not one, I might add, was an experimental launch. All of them had real payloads. We have been successful, and in the last 10 to 12 years, we've been able to launch 47 out of 48 launch attempts successfully. We have competed head to head with our friends at Ariane. We just completed a competition with them in the Pacific with the Indonesians, and we won that competition, not on the basis of cost but on the basis of our relationship in the past, and the reliability of the vehicle.



These are the launch vehicles that we currently are producing. In the middle is the standard Delta 6925 vehicle, capable of putting about 2,800 pounds into GEO-SYNC transfer.

The first configuration of Delta II incorporates improvements that are logical, highly reliable with low risk changes. We are using the same motor cases as the Caster IV's, and simply upgraded them to what we're calling a Caster IVA with higher energy propellants. We're stretching our tanks, and we're putting on a new



COMMERCIAL DELTA/DELTA II LAUNCH VEHICLE CONFIGURATIONS

payload faring that will accommodate the GPS vehicle. It was a requirement of the MLV competition the Air Force conducted last year.

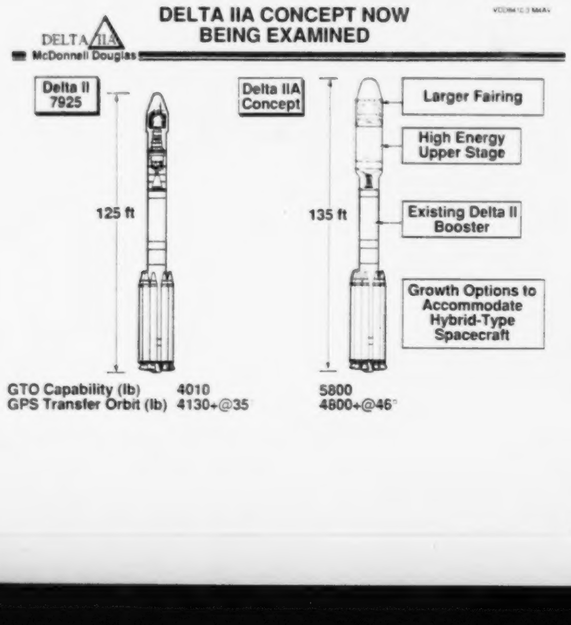
In the final configuration of that vehicle, we've stretched the solids another six feet, and changed the motor case to a graphite epoxy motor case, which gave us the additional energy we needed or the added capability that was required for the GPS program. In addition to that, we did change the expansion ratio of the main engine, so these are the things that we have today.

I might add, since I didn't prepare a presentation totally along the theme of today's activities, I completely endorse what Dick has said. I think that we are facing the situation where we are looking at an excess capability throughout the world, and I think that the competition that the U.S. producers, ourselves, Martin Marietta, and General Dynamics are facing is formidable from the profitability and our ability to cost compete with the other suppliers around the world.

This is our newest offering, another logical growth, we've gone to a high energy upper stage, as Craig mentioned just a minute ago. This is our entry into the current competition with the Air Force for the MLV II.

And with that, I will give it back to Craig.

**MR. COVAULT:** Let's start the questions. I will just fire away here. Dick Brackeen raised an interesting comment on China and Arianespace, and I will ask Doug to comment on it. Doug, if China starts selling payloads, the United States ELV companies have military markets and scientific markets to maintain strong business, but Arianespace is relying more on commercial traffic. Will you reduce your prices to meet the Chinese challenge?



DELTA IIA CONCEPT NOW BEING EXAMINED

DELTA IIA
McDonnell Douglas
Delta II 7925
Delta IIA Concept
Larger Fairing
High Energy Upper Stage
125 ft
135 ft
Existing Delta II Booster
Growth Options to Accommodate Hybrid-Type Spacecraft
GTO Capability (lb) 4010 5800
GPS Transfer Orbit (lb) 4130+@35 4800+@46°

**MR. HEYDON:** I think to some extent, that, of course, would be inevitable. We don't have any alternative except to consider it. We do have the long-term necessity of covering our costs, however, it's not something that could be done on an indefinite basis.

I think the question of meeting artificial pricing is very sensitive, in our case particularly, to such things as currency exchange rates. One thing Dick neglected to point out in his chart is that during the shuttle competition phase, one of the reasons that we were able to compete is that the dollar was about twice as strong as it is today. That does make a very substantial difference.

Directly with respect to the Chinese, I think that in the near term, we would have to consider meeting their pricing, but it's not something that we could carry on for an extended period of time.

**MR. COVAULT:** And for Dick Brackeen: certainly, one of the factors in selling launch services is to convince U.S. companies to Buy America, if possible, but when Martin Marietta went looking for the large type of shroud they had contracted with the European company, CONTRAVES. If you have ever seen a Titan shroud, it's like seeing a small building. Could you comment on why you went to CONTRAVES, as opposed to an American company?

**MR. BRACKEEN:** Absolutely. We have an excellent supplier of payload fairings for Titans. McDonnell Douglas and others have made Titan III fairings, and McDonnell Douglas makes a Titan IV fairing, and also makes the Titan II fairing. The commercial payload fairing had to be larger. It had to utilize a new composite technology, and since there were no existing U.S. programs or tools to build this, we had a competition and invited anybody that thought they could make the product to respond. When you do that, you must be prepared to follow through. I will remind you, Craig, that in Switzerland, where CONTRAVES builds our fairing, they have a free market for labor. They buy all their resources on the open commercial market, as would all of the American bidders, so that is what I would call a free market competition.

**MR. COVAULT:** For Deke: has NASA and the Air Force learned to buy launch services from commercial companies yet?

**MR. SLAYTON:** I don't think so. There's a policy from the White House and legislation that says that government agencies should procure commercial services, as opposed to hardware where available. I think, though, the fly in the ointment is there are still a bunch of federal procurement rules that are in effect. And until those get changed, the people at the working level, who are responsible for implementing this, don't know how to implement it. Dick Brackeen is head of a committee that we're all a part of, and are working that problem diligently. I'm confident we're going to beat it, but to me that's probably the biggest detriment to the possibility right now.

**MR. COVAULT:** For Bill Wirin. You spoke of the proton as a means by which the U.S. could market its satellites, presumably, to other countries. A subsequent speaker described the proton as a means of putting the U.S. out of the launch business. Is the short-term gain in satellite sales worth the long-term loss of our ability to access to space?

**MR. WIRIN:** I think the answer is clearly no, and obviously, that's part of the policy problem which faces the Administration. But I think part of the issue is a false premise, is it all or nothing? Do we "throw the doors open widely" and allow the Soviets, PRC, or whomever, to bid at any price for launches? I think the answer is no; but I think we do have control, by means of the present legislation, and of the export licenses that are required. We ought to permit the Soviets to partake of a piece of the market. I think they will do a couple of very profitable things for us.

One, I would suggest to you that most of the launch manufacturers today are government specifications by the old mil spec. They're not producing a launcher which is truly commercially marketable, that stands a chance of failure. What I'm getting at is this — if you have to have a hundred percent success, then you have to refine your launch vehicle resulting in a very high price. Whereas if you can stand to lose three out of ten, you may be able to produce those seven successful launches far more cheaply than you have to under a mil spec.

And I think this is where our commercial market needs to go, and I would not argue that the Soviets or the PRC ought to be allowed to willy-nilly take over the entire market of launch vehicles.

**MR. RABURN:** Let me make a little rebuttal to that. I really think that where the cost of commercial launch vehicles is going today in this country is not only driven by the spec requirement. I have to admit that does derive some of our costs, but we have done studies that would indicate if we had an adequate base, where we could go out and enhance the competition and our suppliers, we could probably halve the cost of our vehicles today.

We just don't have the base in this country, with the military combined or commercial, where we can really establish second sources and do competitive procurement by way of those launch vehicles.

**MR. COVAULT:** Doug, you've heard this one before. As a percentage of the launch cost, how much is the Ariane government subsidizing?

**MR. HEYDON:** I think the only rational way I can answer that is to say that the only direct or indirect subsidy which I think is fair to imput to our launch cost, is the apportioned price of the use of the range facilities. And I can't put a percentage on that, because it varies, as the price of the launch would.

We pay a rate for the range use which is a function of our launch rate. The percentage of our sales for range use increases as the launch rate goes up.

This is to cover the use of the range facilities, typical fixed facilities, such as meteorology facilities, radar tracking, range safety interfaces, and the like. And to the extent that that does not cover the full cost of operating the range, that could be considered as a partial subsidy. The fact is that the Arianespace contribution to the operation of the CSG range is on the order of 40 to 50 percent. And I think if you look at the proportionate contributions of our U.S. competitors, I don't think it's any better or any worse. I don't know the numbers in the U.S. on a percentage basis, but I think the basic operating ground rules are very similar. We pay full direct costs for all consumables and services provided on a direct basis. So I can't answer the question as it's directly phrased, but there is a proportionate use for the range, which I believe is quite similar to the setup in the U.S.

**MR. COVAULT:** Okay. And I think we better make this the last one, to keep the program on schedule. We have approximately 25 questions up here. A broader one from the audience: Would an industry association, comparable to the International Air Transport Association, be appropriate for the new commercial space transportation industry? Would standardized payloader interfaces provide a forum for providing technology transfer and competition between East and West issues?

Anybody like to tackle that?

**MR. BRACKEEN:** Yes, I think that's probably a wise consideration for the future. Bear in mind, we have been in an era that has by necessity had to depend heavily on dialogue with the government, the Department of Defense, to hammer out these arrangements. It's very similar to what Doug Heydon described for Ariane, that is the Delta, the Atlas, and the Titan, would pay a reimbursement based on the cost.

The old era is passing, and as we now are getting some experience in the marketplace and confronting some of these issues, the dialogue has been primarily through government committees. These government committees might readily be moved to an industry association.

**MR. COVAULT:** Anybody else want to comment on it?

**MR. WIRIN:** I would concur. I think that part of the problem with the acceptability of a proton launch authorization as far as the State Department and Department of Commerce is concerned is that industry would get up in arms, and possibly through an industry association where those concerns can at least be addressed, maybe there might be some light at the end of the tunnel.

**MR. RABURN:** I was just going to say that I was in a conversation at lunch that centered somewhat on this. It is a fact that in the normal growth of the industry, in the next several years, where there's more universal use of space, I think it's going to necessitate some standards, like interfaces that will make it possible for retrieval of satellites and repair of satellites. That's a technology that really is ill-developing, but I guess I agree with Dick. Probably, it is inevitably a need for the industry to get together and help standardize, to some degree, so that it will allow us to interface with more satellites around the world.

**MR. HEYDON:** I don't want to get left out. Many of you already know that there has been an informal working arrangement between all of us represented on this panel, with the exception of Proton, for standardizing interfaces. That is, we have shared users manuals, freely and openly. We've put each other on control distribution lists so that we don't inadvertently stumble over interface changes. We are trying to do that on an informal basis, and I think this suggestion would tend to formalize it and I support it in the long run.

**MR. COVAULT:** Another question for Dick Brackeen: Martin Marietta has recently contracted with CONTRAVES and Dornier to provide structure components for the commercial Titan. Was this an effort to offset Ariane's political clout? Would you consider doing something similar with the Chinese or the Soviets to cut cost and stay competitive?

**MR. BRACKEEN:** The Martin Marietta awards to Dornier and CONTRAVES were both the result of competitive prices. There was no attempt to gain political position in Europe in either of these selections

On the other question, the company has no intention of aligning or subcontracting with the Soviets or Chinese in the space launch business.

**MR. COVAULT:** If Vandenberg and Kennedy are not available for launch facilities for a number of reasons — where do you intend to launch?

**MR. BRACKEEN:** We have every reason to believe that the Cape Canaveral and Vandenberg launch facilities will be available to commercial Titan when we need them. Our contract with the Federal Government states that we will be pre-empted from access to those sites only in the event of a "dire national need," and that will take a determination by the Secretary of the Air Force.

**MR. COVAULT:** I think we better finish up to keep the program on schedule. All of your questions that have been submitted will be distributed and answered in writing for the record.

In summary, we've had largely a business discussion here this afternoon, but the bottom line will always be running safe and cost- effective flight operations. It's still a challenge, and a risky business to get several hundred thousand pounds of space vehicle rolling, and that will always be the same. It will always be a high risk business.

Thank you.

**QUESTION FOR DOUG HEYDON:** For Government launches, how does "launch services" deal with a launch failure and loss of satellite?

**DOUG HEYDON:** "Government" launches can be, and are, treated in exactly the same fashion as any other commercial launch, if the customer wishes to avail itself of the Launch Risk Guarantee (LRG) which is made available to all customers on an optional basis. In other words, if a government customer does not wish to self-insure (as has been the past practice in most cases), it can elect to take the Arianespace LRG coverage, which provides for a reflight in case of failure or, for a slightly higher fee, a cash indemnity. Satellite coverage during the launch phase and the usual coverage during the deployment and check-out phase must still either be procured on the world market, or provided through self-insurance. The LRG provides coverage only during the launch phase, from opening of the table clamps ("liftoff") through satisfactory separation in transfer orbit.

**QUESTION FOR BILL WIRIN:** What guarantee do we have that the Soviets will not copy the electronics and computer technology of the satellites they launch?

**BILL WIRIN:** The Soviets in the commercial contract signed with Space Commerce Corporation have guaranteed that the satellite and all test and other equipment will not be subject to inspection by the U.S.S.R. The contract goes on to provide that we may place security guards continuously on the satellite and associated equipment. We propose in conjunction with an export license to have U.S. government personnel perform that service. Should the U.S. government choose not to provide its personnel, we have a private protection agency who is ready.

**QUESTION FOR BILL WIRIN:** Don't you think that by giving "business" to the Soviet Union in the space program, we are supporting the "communist system?" Should we not use that money instead to restore our space program? I don't believe that by giving them business they are going to turn around and be our best friend. History has proven that they can't be trusted.

**BILL WIRIN:** International trade exists not because the United States agrees with the political philosophy of another nation, but rather because American business believes that a market for the product or service exists and a profit can be made. This is what "free enterprise" means. Free markets ought to be limited only to the extent that national security is involved. National security is not a consideration. The U.S.S.R. will continue to have a strong launch program regardless of any sales of proton boosters. Our national security may however be adversely affected in two ways. The U.S. currently enjoys 85% of the satellite construction world market. Other nation's companies will step in and use the proton if it is a money maker. Secondly, attempts to shore up the U.S. launch industry only continues reliance on uneconomical launch systems and postpones U.S. effective competition for space business. Moreover, I do not believe that the U.S.S.R. will become our "friend," but to the extent we trade with each other and understand each other better, the likelihood of war is lessened. I also believe it is in the national security interests of the U.S. to see General Secretary Gorbachov succeed in his economical reforms. If he fails, others may come into power who are prepared to take by force of arms what the Soviet Union needs. I am reminded that recognition and trade with the Peoples Republic of China has led to a more peaceful world.

# MOON MARS AND BEYOND

*Moderator:*
**Dr. Norine E. Noonan,** Chief, Science and Programs Branch, U.S. Office of Management and Budget

*Speakers:*
**Dr. David Webb,** University of North Dakota, Member, National Commission on Space
**Dr. Robert M. Wood,** Director of Advanced Systems Technology, Space Station, McDonnell Douglas Astornautics Co.
**Dr. James "Ox" van Hoften,** Manager, Space Programs, Bechtel National, Inc.
**Dr. Lowell Wood,** Senior Staff Physicist Lawrence Livermore National Laboratory

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**MR. MACLEOD:** The next panel is designed to be open-ended to allow the speakers a fair range in discussing "Moon, Mars, and Beyond." We've heard about Space Station, we've heard about the launch vehicles; now, let's take a look at what comes next, what is being planned next, what **should** be next.

And to guide that discussion, we have for the first time a representative of the Office of Management and Budget, and we think a stellar one. Dr. Norine Noonan is Acting Branch Chief of the Science and Space Program Branch, Energy and Science Division of the Office of Management and Budget. This branch encompasses programs and budgets for the National Science Foundation, NASA, Office of Science and Technology Policy, as well as the Smithsonian National Gallery of Art, and the Woodrow Wilson National Center for Scholars.

Dr. Noonan is also responsible for monitoring government-wide support for research and development activities, and the preparation of the annual budgetary Special Analysis on Research and Development.

Before joining the staff of OMB in July 1983, she worked on the staff of the Science Technology and Space Subcommittee of the Senate Commerce Committee and was a consultant to the Science Research and Technology Subcommittee of the House Committee on Science and Technology.

She's a member of Phi Beta Kappa, Sigma Xi, and a number of professional scientific societies. She served on the faculty of the Schools of Medicine and Dentistry at Georgetown University, and the College of Veterinary Medicine at the University of Florida. She has a B.A. from the University of Vermont, and a Ph.D. in biology from Princeton. Dr. Norine Noonan.

*DR. NORINE NOONAN presently serves as Acting Branch Chief of the Science and Space Programs Branch, Energy and Science Division of the Office of Management and Budget. This branch encompasses programs of and budgets for the National Science Foundation, NASA, and the Office of Science and Technology Policy - as well as for the Smithsonian Institution, National Gallery of Art, and the Woodrow Wilson International Center for Scholars. Before joining the staff of OMB in July 1983, Dr. Noonan worked on the staff of the Science, Technology and Space Subcommittee of the Senate Commerce Committee, and was a consultant to the Science Research and Technology Subcommittee of the House Committee on Science and Technology. A member of Phi Beta Kappa, Sigma Xi, and a number of professional scientific societies, Dr. Noonan served on the faculty of the Schools of Medicine and Dentistry of Georgetown University, and the College of Veterinary Medicine at the University of Florida. She has a B.A. from the University of Vermont, and a Ph.D. in Biology from Princeton University.*

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**DR. NOONAN:** Thank you. I think the most important thing in that whole c.v. in terms of my experience at OMB is that I was a faculty member at the University of Florida in the College of Veterinary Medicine, and there I taught anatomy and surgery, so I'm very used to cutting up things.

I tried to think of a good opening for this session, because I find the irony rather delicious. When I was asked to chair this, and I'll explain that in a moment, my two best openings: "A Long, Long Time Ago In A Galaxy Far, Far Away," and "Space The Final Frontier," had already been taken.

Well, I've been at OMB for almost five years. However, when I first came to OMB, I was the budget examiner for the National Science Foundation and had responsibility for the aeronautics programs at NASA, so I'm really new as a space cadet, but I found it very rewarding, extremely frustrating, but never, ever boring.

Again, when I was asked to chair this session — and I appreciate the opportunity — I thought the irony was rather delicious. We had just in the Administration, as you've heard referred to today, completed a review of National Space Policy, and as part of that review, there ensued a rather spirited, shall we say, discussion over the issue of whether or not to adopt as a new, long-range goal for the nation, the expansion of human presence beyond earth orbit into the solar system.

Well, you might hazard a guess where OMB stood on this issue, and frankly, you would only be partly correct.

Our role in the policy review, as we saw it, was really to insert a doctrine of what we like to call "truth in space policy-making" or "full disclosure" on the part of the agencies.

Of course, we had our preferences as to the outcome, but mostly we were there to ensure that the agencies disclosed the full implications of changes that they were asking the President to make.

Well, to that end, we were satisfied that the goal of expanding human presence was appropriately structured, and that there was a good, solid program, and that program is Pathfinder. Some of you who know the NASA budget know that the FY 1989 budget proposes one hundred million dollars for the first year of the Pathfinder technology program. Pathfinder, we think, is going to help us to start to develop the technologies we will need to make rational and informed decisions in the future about specific missions.

It is our hope in the Administration, and my personal hope, that the Congress has the vision and foresight to support the Pathfinder program particularly, and the space program generally.

I think it's in that context that we convene this session today. I'm very pleased to be here. My panelists have all agreed to limit their remarks to about five minutes, so that we can have a maximum time for your comments and questions. I hope you will participate vigorously and contribute to the success of our efforts.

**It is our hope in the Administration, and my personal hope, that the Congress has the vision and foresight to support the Pathfinder program particularly, and the space program generally.**

*DR. DAVID C. WEBB was appointed by President Reagan as one of fifteen members of the National Commission on Space in 1985, to prepare a 50-year agenda for the U.S. in space. The Commission presented its report to the President and Congress in June, 1986, after 15 months of research. Prior to that, Dr. Webb was a consultant on space policy and development in Washington, where, for eight years, he was actively involved in lobbying for a more aggressive and visionary U.S. space program. Born and educated in Ireland, he attended university in Canada, where he received his Bachelor's and Master's degrees from McGill University in Political Science and International Relations. Later, he attended the University of Pittsburgh to receive a Ph.D. in International and Development Education. After ten years as Director of a major Canadian philanthropic foundation, Dr. Webb came to the United States in 1978 and spent 18 months in study at NASA Headquarters, the Library of Congress and the Smithsonian Institute in all aspects of space exploration and development. He is currently teaching at the University of North Dakota.*

Our first speaker today is Dr. David Webb. He's going to introduce himself, and I don't like gushy introductions anyway, so without further delay, Dr. David Webb.

**DR. WEBB:** Ladies and gentlemen, I am sorry that I didn't deliver my bio, but as some of you may know I have been involved actively in the space field for some time; now, nearly 15 years. I spent a lot of time in Washington D.C., as an independent consultant on space development and I've got the bloodied fingernails to show for it. In 1985, I was appointed to the National Commission on Space, and after that very interesting experience I became Chairman of the Space Studies Program at the University of North Dakota, where I am now.

**I think that we are, in fact, now recovering from the bottom of a long decline that actually took place over 15 years - from about 1974 to about 1988.**

Originally, we were asked to talk for 20 minutes. That now has been cut by 75%, so in the next five minutes, rather than attempt to give my original presentation, I will quickly review some of the changes that have taken place since I stood here one year ago. It is very interesting what has happened in the space field in the past 12 months. I think that a year ago, we bottomed out. I hope we did. I think that we are, in fact, now recovering from the bottom of a long decline that actually took place over 15 years - from about 1974 to about 1988. We have an awfully long way to go to get back out of the mire in which we unfortunately find ourselves at this time, but there are very helpful signs indeed that we are on our way at last. The Administration's new Space Policy I think is excellent. I'm glad to see that at least there is some activity because there were rumors that this Administration was not going to do anything further in the space field. Recently, they even resurrected the National Commission on Space report, from whatever pigeonhole it was in in the White House basement. Apparently, it was even given back to the President, and I guess some good may have come out of that.

**The Administration's new Space Policy I think is excellent.**

As you know, we've also had the Ride Committee Report, although, in most areas it didn't say anything too far different from the National Commission, at least the government is now on record through NASA, in supporting the same kind of future activities in space. So today we find ourselves talking about the Moon, Mars and Beyond.

Now, that is a very unusual situation, because two years ago there would be no way in which that subject would have been discussed as a major panel item in a conference such as this. In fact, there was no such thing as future imaging a year and a half ago, or even a year ago. We were still looking back at the past, looking at the problems.

It now appears as if that period is over, and it looks also as if the Great American Engine is starting to gather itself. When I refer to the Great American Engine, I am, of course, referring to the commercial entrepreneurial organizations. I wish that I could include all aerospace corporations under that heading. I'm afraid I cannot, for as we all know, the aerospace corporations are contractors first, and entrepreneurs, second.

However, there is undoubtedly a move in the aerospace corporations, to start lobbying for space. Having been doing precisely that for ten years, I can assure you it's the very first time that has happened since 1975.

**The Soviets are going to go to Mars, almost certainly within the next ten years, but we are not going within that time frame. At this time, we have no capability in this country for launching human beings into space, other than the shuttle.**

These are very significant changes. We must not underestimate them, but at the same time we must not go off the deep end in talking about Moon, Mars and Beyond, even with all the agendas that have been laid out by the National Commission, and by the Ride Report. Unfortunately, if we start too fast down this road (about Moon, Mars and Beyond) before we've learned to get off the earth, we are going to get ourselves into very serious trouble. In the space community right at the present time, nobody that I know of appears to be really concerned about how the next load of passengers, settlers, colonists, call them what you like, are going to go into space; yet we are talking about manned trips to Mars with the Soviet Union. With what?

The Soviets are going to go to Mars, almost certainly within the next ten years, but we are not going within that time frame. We will be darn lucky, if we get back to the moon in ten years. At this time, we have no capability in this country for launching human beings into space, other than the shuttle. The shuttle will fly military and astronaut crews only from now on in. So, when we're talking about Moon, Mars and Beyond, we better fully understand what we mean.

One of the most important factors is how do we leave here to get there, with what, and then, when we've done that, how do we keep the people alive? No one has yet done the work that is required to keep people alive in space over a long period of time. If we're talking about a dash to Mars, as Carl Sagan and the Planetary Society would like, we are talking about a three-year round trip. Yet, we do not now have the capabilities to keep people alive for three years in space. We do not have the closed ecological life support systems. Nor do we have the capacity to develop them quickly, unless we're going to spend many billions of dollars. Unfortunately, I do not see the Congress of these United States going for such a venture in this time of major economic and budgeting attacks. I don't think that we can afford to spend a great deal of time, effort and energy wondering about the next series of steps, when the most important thing now, is how we get the cost to orbit down to a level to which the people can afford (and by the people, I mean the entrepreneurs, and hopefully, the future space settlers). And how are we going to be able to develop the closed ecological support systems that are demanded before we can venture to put any American citizens into space over a long period of time?

**I don't think that we can afford to spend a great deal of time, effort and energy wondering about the next series of steps, when the most important thing now, is how we get the cost to orbit down to a level to which the people can afford**

These are vital issues, yet almost no work is being done on them. Regarding launch vehicles, NASA at the present time, is still talking about the follow on Shuttle 2. And, as we know, the X-30 is being designed and developed by DOD, but it is strictly a military aerospace plane. This issue is going to cause enormous problems for us in the space community if we do not come to grips with it now, because it is essential that we have the civilian version of the hypersonic in operation at the earliest time. This is going to be very difficult because of the lack of publicity, available information about the capabilities of this new vehicle. Meanwhile, the Japanese, British, Germans and Soviets are developing their own commercial hypersonic aerospace planes. Unless we are careful we will end up with the best military hypersonic vehicle in the world, while flying Japan across the Pacific, and Europe across the Atlantic. If we don't get the technology out into the open where it should be, so that it can go through the normal peer and public review process that all major technology developments in this country should go through, then we are likely to have problems. The failure of the SST program is a classic example of the public not being made aware, in advance, of the purpose and value of a new technological development. We do not want a repeatal with the hypersonic. The end result would be that we will just simply fall further and further behind everybody else in our development of space, and this time, I'm just not talking about the Soviets, I'm talking about the Japanese, the Europeans, and all of the others who are and will be crowding in on them. This new vehicle is essential to maintaining our access to space. We need to have it available at the earliest possible time. If there's one plea that I may make, it is that before we start talking about Moon, Mars, and Beyond, let's talk about getting to low earth orbit, at a price we can afford. From there, everything else will flow.

**If there's one plea that I may make, it is that before we start talking about Moon, Mars, and Beyond, let's talk about getting to low earth orbit, at a price we can afford. From there, everything else will flow.**

Thank you very much.

**DR. NOONAN:** It's a funny feeling being a moderator. This is the first time I haven't been able to speak my mind. Our next panelist is Dr. Robert Wood.

Dr. Wood is at McDonnell Douglas Corporation. He is Director for Advanced Systems and Technology for the newly formed Space Station division of McDonnell Douglas, and I was privileged to be able to visit with those folks earlier this week.

I think Dr. Wood may hold the record on our panel for longevity in the space program. He took a summer job in 1946 for General Electric, plotting data for the German V2 firings at White Sands. That was some years before I was born, so I think he does hold the record. Dr. Wood?

*DR. ROBERT M. WOOD is the Director, Research and Development, MDAC - Huntington Beach. Dr. Wood is responsible for the overall planning, budgeting, and fiscal monitoring of all IRAD at MDAC - HB and monitors contracted research and development programs. He also worked as; Acting Director of the Vehicle, Energy, and Biotechnology subdivision, Assistant Director of the Ballistic Missile Denfense Systems Technology Program, Director, Advance Technology for Strategic Defense Programs, Deputy Director of Research and Development for missiles and space systems, and Chief Research Engineer and Deputy Chief Engineer, Advance Space Technology. Dr. Wood received a B.S. in Aeronautical Engineering from the University of Colorado and a Ph.D. in Solid State Physics from Cornell University.*

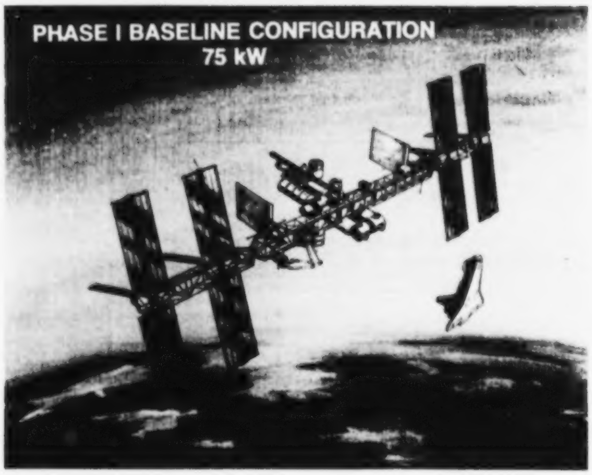
**DR. ROBERT WOOD:** Thank you, Norine.

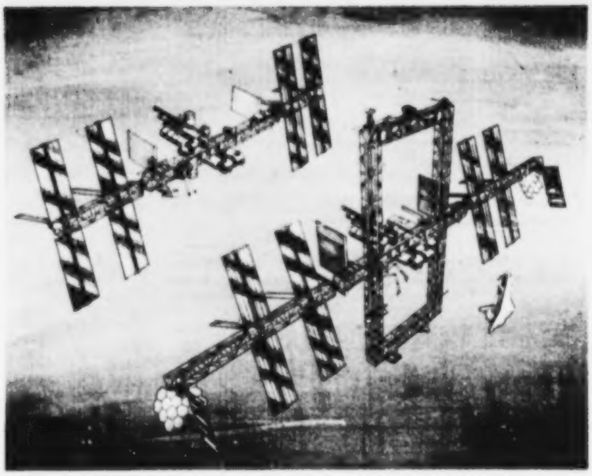
Space Station technology and Moon/Mars missions are the focus of my few remarks right now, and I want to begin with a little philosophy.

> **John Kennedy came along, and said, "I want to place a man on the moon within the decade." For the first time, we had a budgetary view of one decade at a time.**

We live in a world of cycles: We have a daily temperature cycle. We have a weekly paycheck cycle. We have a monthly billing cycle. We have a nine-month cycle to have children. We have an annual income tax and party cycle, and every two years, we have an election; every two years, we elect Congressmen and every four years, we elect the President, and every six years we elect senators, and that's the way it was from 1778, until John Kennedy came along, and said, "I want to place a man on the moon within the decade." For the first time, we had a budgetary view of one decade at a time: and now that's been further extended by the Space Station, which NASA began in 1984 and was endorsed by President Reagan: this program will have a life span of approximately 30 years, or three decades.

So how do you handle the associated management and technology requirements over the decades spanned? Well, part of the answer is, you invent some language to cover such subjects: "hooks," and "scars," and "technology transparency" are the words that are currently used by NASA when discussing efforts to make the station as cheap as possible and flexible to absorb new technologies as they come on line.

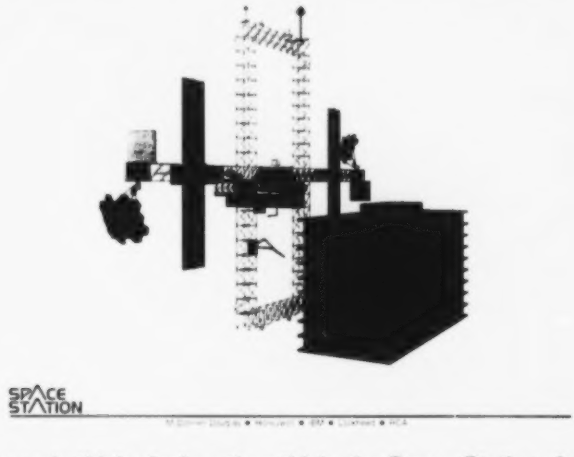




The Space Station (Phase 1 Space Station and Phase 2 Space Station) will be in orbit in the late 1990s, and it will be used, for example, where you have a lot of heavy complex orbital assembly work such as building a lunar transportation vehicle.

It, of course, has power added over the Phase 1 version as well as greater work area.

This slide shows the size compared to the ten-story building. The Space Station is about three hundred feet high, and five hundred feet long. The Space Station is more than just a laboratory in space and a permanent observatory, although those are the things that most people think of when they think of a Space Station. As this slide notes, it is also a servicing platform, transportation node and a staging base.



### SPACE STATION

- A laboratory in space
- A permanent observatory
- A servicing facility
- A transportation node
- An assembly facility
- A manufacturing facility
- A storage depot
- A staging base

**Space Station is a multi-purpose facility**

SPACE STATION

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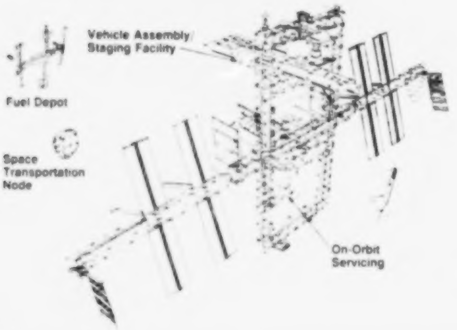
### STEPPING STONE FOR HUMAN EXPLORATION OF SOLAR SYSTEM

VJP950



SPACE STATION

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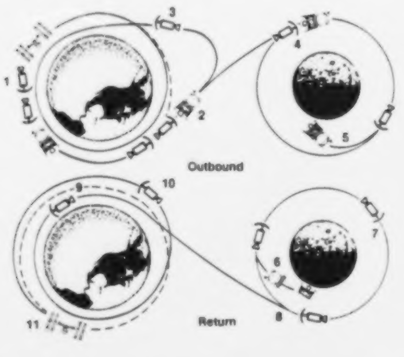
The functions being performed on the previous slide are shown on the next slide schematically: the transportation node, a fuel depot, a staging facility, and on-orbit servicing. Settled inside the framework you can see a possible lunar vehicle, (perhaps without the propellant); you have begun to imagine that we would use the Space Station for the beginning and starting point for these missions.

Here, for example, is the lunar mission, and the key point about this slide is that everything starts with the equipment in orbit at the Space Station. At position 2, you have a couple of transfer vehicles pushing the landing vehicle to the moon; then you land, and then at position 6 the ascent vehicle leaves the descent stage behind, as we did in Apollo, and then it does some aerobraking in the earth's atmosphere in one pass, thereby saving weight for the whole mission. Now, that type of infrastructure is also applicable to the Martian mission including aerobraking at Mars.

### LUNAR BASE INFRASTRUCTURE

VJP945



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**The question is how can we use technology in order to make this whole program cheaper or better or do it sooner, or have it safer?**

But, the question is how can we use technology in order to make this whole program cheaper or better or do it sooner, or have it safer? These were four adjectives that we found comfortable to use during the Phase B Space Station program because fundamentally, there are no enabling technologies required for the Space Station, as evidenced by the Skylab we built some 15 years before.

On the other hand, there are some enabling technologies required for the Martian mission, as Dr. Webb just mentioned. We do not have the data to design the life support systems. We do not have the data to assess the influence of zero g, and we do not have the data or the designs planned for a proper shielding of the astronauts on the way. So we do have to collect some data, but in addition to that, there are some general requirements, where we don't really need much more data. You know you're going to want a data management subsystem. You know you're going to want a communications and tracking sub-system and other subsystems essential for operation.

So what we did was take a quick look to get the expected requirements for a lunar mission, apply them to the Space Station, and ask if we could satisfy them with the designs we have. Here are the Phase 1 configuration

### PHASE I CONFIGURATION

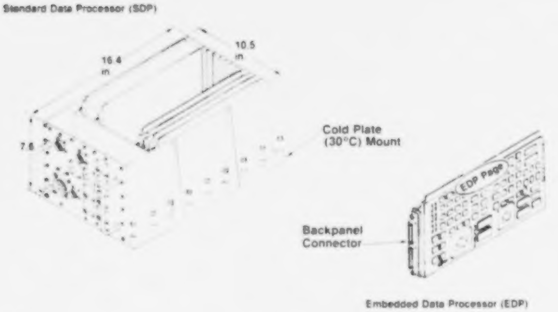
VJP947

| | |
|---|---|
| Crew: | 8 |
| Environmental control: | Closed loop |
| Thermal control: | Active (two-loop, two-phase) and passive |
| Power system: | 75 kW photovoltaic, 400 VAC, 20 KHz |
| Data management: | 32 bit 4 MIPS processors, 100 MBPS fiber token ring network |
| Communications: | Space-ground (Ku- and S-bands)<br>space-space (Ku-band), audio, video |
| Propulsion: | H/O, resistojet |
| Guidance, navigation and control: | CMGs, reaction jets, star trackers, inertial sensors |
| Extravehicular activities EVA: | High pressure suits, airlocks, FTS, SSRMS |
| External payload pointing: | Coarse pointing systems |
| Laboratories: | U.S. Lab Module<br>ESA Columbus Module<br>Japanese JEM and external facilities |

SPACE STATION

McDonnell Douglas • Honeywell • IBM • Lockheed • RCA requirements, and we just picked three avionics subsystems: data management, GN & C, and power, and asked ourselves how much could we save to do the lunar mission. This slide shows the standard data processor made by IBM, who last year won the NASA excellence award for the reliability of their shuttle computer. It basically is made of standard but hardened electronics and is expected to be perfectly applicable to a Martian mission. The guidance navigation and control components shown are to be made by Honeywell. The attitude determination system requirements for the spacecraft are 0.003 degrees, and the star tracker does twice as well as that. The CMG is 200 foot pounds, and has a life of ten years, which again is probably going to be adequate.

### DMS STANDARD DATA PROCESSOR (SDP)



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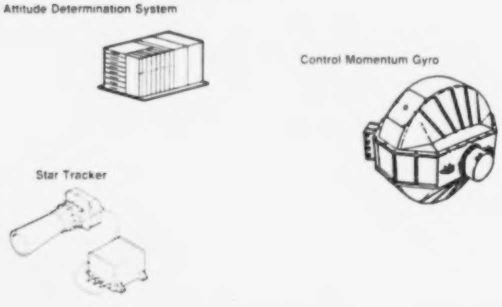
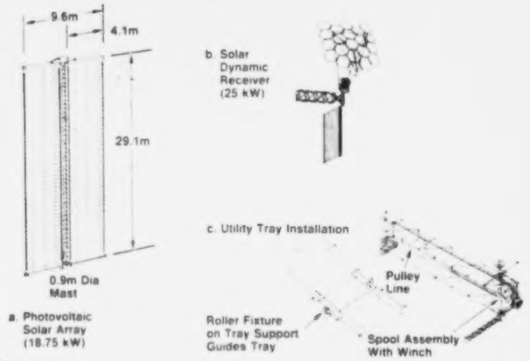
### GUIDANCE, NAVIGATION AND CONTROL COMPONENTS



McDonnell Douglas • Honeywell • IBM • Lockheed • RCA

And then finally, the space power elements shown are all expected to be easily extrapolable for ten years. We (MDC) are building the spool assembly, and the utility truss. The other parts of the space power system are built by contractors in the other work packages.

### SPACE STATION POWER ELEMENTS


9.6m
4.1m
29.1m
0.9m Dia Mast
a. Photovoltaic Solar Array (18.75 kW)
b. Solar Dynamic Receiver (25 kW)
c. Utility Tray Installation
Pulley Line
Roller Fixture on Tray Support Guides Tray
Spool Assembly With Winch

McDonnell Douglas • Honeywell • IBM • Lockheed • RCA

If you continue to assess other avionics subsystems, you ask which ones and what components are perfectly applicable to a lunar lander and/or a surface installation? The results are shown where the X's are. Thus, we could save a lot of time and money by using Space Station parts that will be available in the next decade.

### APPLICATIONS OF SPACE STATION AVIONICS TECHNOLOGY IN A LUNAR BASE

| | Lander | Surface Module |
|---|---|---|
| Data Management System | | |
| SDP | X | X |
| EDP | X | X |
| 100 MB/s F/O Network | | X |
| Local data busses | X | X |
| MSU | | X |
| Ring coupler | | X |
| MDMs | X | X |
| Software | | |
| MISF | X | X |
| SPF | X | X |
| SDF | X | X |
| SSE | X | X |
| OMA | X | X |
| OMGA | X | X |
| Built-in-test | X | X |
| Expert systems | X | X |
| Other low level code | X | X |
| Communications and Tracking | | |
| Multiple access Ku-band transc. | X | X |
| Multiple access Ku-band antenna | X | X |
| Internal audio, video | X | X |
| EVA radio | X | X |
| Data collection equipment | X | X |
| Guidance, Navigation and Control | | |
| Star trackers | X | |
| ISA | X | |
| CMGs | | |
| RCS | ? | |
| Earth sensors | X | |
| Power | | |
| Photovoltaic array | | ? |
| Solar dynamic receiver | | ? |
| Batteries | X | ? |
| 20 KHz PMAD | | ? |
| Utility tray | | X |

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Let me summarize by noting that we're looking for the technologies that have the greatest payoff in terms of cost, performance and/or safety and I would be inclined to say that weight affects these payoffs because obviously weight converts to money. Where you save money directly on very expensive subsystems such as the life support, it is really an enabling subsystem because it is very important not only to ensure the safety but also the comfort of the astronauts.

Finally, I close by saying one other tool that I have found helpful in assessing new technologies is to look at the quicker, safer, cheaper, sooner in the context of risk management: that is, a reduction of a life-threatening risk is safer, a reduction of technical risk is better. A reduction of schedule risk is sooner, and a reduction of cost risk is cheaper. If you know why you're doing these technology projects in the context of one of these risk reductions, you always have a big advantage.

> **We are prepared to help NASA "go where no man has gone before"... at lower cost.**

I would look for reductions in costs associated with commonalty, associated with increased productivity, and associated with getting technology results free. (The classified technology that Dr. Webb referred to or the NASP technology both which look very impressive.) And so my summary is that — and I'll put my commercial in now — we are prepared to help NASA "go where no man has gone before"... at lower cost.

**DR. NOONAN:** We're going to have to start charging for advertising time.

Our next speaker is Dr. James van Hoften. I think he likes to be called "Ox." I must find out how you got that name.

Dr. van Hoften is Manager of Space Programs for Defense and Space Business Line at Bechtel National. Prior to that, he was an astronaut with NASA for eight years, flew on two missions, 41-C on Challenger, and 51-I on Discovery, and performed EVAs on both occasions. In the late 1970s, from 1976 until 1978, he was an Assistant Professor of Civil Engineering at the University of Houston.

In this we have something in common. He taught and performed research in fluid dynamics of artificial human organs. He has a Bachelor's degree in civil engineering from U.C. Berkeley, and a Masters degree and Ph.D. in hydraulic engineering from Colorado State University in your sister city, Ft. Collins. He's an associate fellow of the AIAA, and a member of the American Society for Civil Engineering at Sigma Xi. Again, we have something in common. Ox.

**DR. VAN HOFTEN:** Thanks a lot, Norine.

It is my impression, and my wife agrees, that it's a bit depressing listening to the stories that we're hearing, especially about commercial space programs, and the idea that the business is not progressing as we had all hoped.

Dr. Webb has said that even though there's a down side to all this, we're starting to look forward in developing newer concepts and ideas. While it is critical that we rapidly get back into orbit we must begin to pay more attention to what we will do once we are there.

I would like to make a some what different pitch today. I am a civil engineer, and I have joined a company that is not well known in the aerospace industry. A point I would like to make is that as we begin to examine these new concepts, the new enabling Pathfinder technologies that will be required; that the concept of building, constructing, and procuring, on this planet or not is currently not resident in the aerospace companies today.

*DR. JAMES D.A. "OX" VAN HOFTEN is Manager, Space Programs for the defense and space business line of Bechtel National, Inc. He is responsible for all Bechtel's activities in government and commercial space programs. Prior to joining Bechtel, Dr. van Hoften was an Astronaut with NASA for eight years. He flew on two space shuttle missions; STS 41-C on Challenger in April 1984, and STS 51-I on Discovery in August 1985. On each mission he performed extravehicular activities (EVAs) to retrieve and repair inoperable satellites. His additional duties at NASA included two years as head of the Astronaut Support Group at Kennedy Space Center; and two years leading the Entry Simulation Testing Team at the Rockwell International Flight System Laboratory. From 1976 until 1978 Dr. van Hoften was an Assistant Professor of Civil Engineering at the University of Houston, where he taught and performed research in fluid dynamics of artificial human organs. He obtained his Bachelor's degree in Civil Engineering from the University of California, Berleley, and his Masters and Ph.D. in Hydraulic Engineering from Colorado State University in Fort Collins. He has served six years active duty as a carrier pilot in the U.S. Navy and ten years as a reserve officer in the Navy and Air National Guard. Dr. van Hoften is an Associate Fellow of the AIAA, and a member of the American Society of Civil Engineering and Sigma Xi.*

In fact, they're coming to us, now, as a company that has been doing this for 90 years, and saying, how do we accomplish these tasks? How can you help us build a bridge from the technologies of today to the needs of tomorrow?

Engineering-construction companies are the people that you normally don't hear about. These large support structures, including the launch pads at Cape Canaveral, KCS, and Vandenberg Air Force Base, were all required to get the flight hardware into the air. All of them were designed, procured and constructed by companies such as Bechtel.

These launch facilities that you're familiar with on both coasts are a tremendous investment of dollars, multi-billion dollar efforts.

**You are about to see some new players in the game, and we plan to be one of them.**

The costs are even more staggering when we talk about going to a foreign planet.

And when we talk about developing something like this NASA sketch, my first thought is where do we get the technology? How do we develop an ability to go do something like this? You won't find it in the aerospace world as it now exists.

You are about to see some new players in the game, and we plan to be one of them. Why do we feel qualified to play this game? Well, a few quick examples of things that sure look like they were built on the moon, are in order.

This is the Lupin gold mine, that was built in the Northwest Territories of Canada some 65 miles from the magnetic North Pole. It is in an area totally inaccessible by anything but airplanes. It took thirteen hundred flights in a C-130 Hercules aircraft to bring in all the pieces required to put this gold mine together, and it was put together over a two-year period in a extremely hostile environment, a climate with temperatures frequently down to 65 degrees below zero and wind chills down to 100 below. Not a great place to work. To facilitate access between areas of the mine complex, from the living quarters to the work areas, for example, there were underground tunnels, which will likely be seen on the lunar surface as well. This mine was quite successful.

Another example of how to deal with the elements is in Dr. Webb's backyard. The Coyote Power Plant was built over the winter in an equally harsh climate in Beulah, North Dakota. To enable year round work they constructed a large dome over the top of the site, an air inflatable bag, with a number of airlocks to get the equipment in and out.

With many gas-powered heaters inside, they were able to keep internal temperatures up to 60 degrees, while it was 50 degrees below outside. They poured some 25,000 cubic yards of concrete in five months and brought this project in ahead of time and under budget. The winners in the engineering construction industry are the that are able to construct and build in remote hazardous environments in a profitable and affordable manner.

One last example is the construction of a modular base. This is a slide of the Polaris lead and zinc mine. This mine is only nine hundred miles south of the North Pole. There is a very small window of opportunity of about four weeks each year that allows access by sea. This large processing plant, which included all the administration offices and facilities necessary to process the ore as they brought it out of the ground, was constructed in Canada, towed to the site and positioned in the excavated harbor. This is one way of performing modularized construction that you will surely see as we go forward to building on the moon and beyond.

Lastly, we have a robotics capability that is quite interesting. As we worked with one of the aerospace companies proposing to NASA on a robotics projects, it became apparent that there's quite a bit of robotics expertise that resides outside of the aerospace industry. This slide shows a little robot that was used for the decontamination project at 3-Mile Island. It was hardened against radiation, and lowered down into the containment facility. By tele-operation it ran around taking pictures of the damage in the containment facility, and then more advanced robots followed on to de-water and decontaminate. It was a fascinating project.

Lastly, how do I think we'll get into this game? Well, we'll do it with the bright engineers we have today, using the systems that we have developed for our new programs. You don't see very many drafting tables around anymore in engineering offices. You see these 3-D computer-aided drafting and design systems, coupled with a number of proprietary programs that we've developed for walk-through visualization concepts that all help simulate the new facilities before they are attempted. Being able to change, modify and present them to a client is really a fascinating way to do things.

One thing I found since leaving NASA is this steady flow of people asking how to become more involved in the space program. We had a drawing made for our office that sits outside of my door, as a sort of inspiration for these folks. It illustrates the transition from hard hat to EMU. This is the underlying theme of our program.

**How do I think we'll get into this game? Well, we'll do it with the bright engineers we have today, using the systems that we have developed for our new programs.**

I could be accused of progressing backwards on this picture. If I have, I am just planning to stop long enough to lead the way back to the future. Thank you very much.

**DR. NOONAN:** The last panel of the day always has the unenviable task of trying to make up some of the schedule time, in order to leave some time for questions.

Just a moment of introduction for our next speaker. Dr. Lowell Wood is the Senior Staff Physicist at Lawrence Livermore National Laboratory. At Lawrence Livermore, he leads the Special Projects Program in the Physics Department and is also a member of the the Directors Technical Staff. He received his Bachelors of Science in Chemistry and Mathematics from UCLA, and his Ph.D. in Astrophysics also from UCLA in 1965.

He's a recipient of lots of awards and honors; I think one in particular is notable. In 1981, he received one of the highest awards the Department of Energy gives, which is the E.O. Lawrence Award for contributions to

**National Security. But he may receive an award yet for contributions to our panel, being last, so without further ado, Dr. Lowell Wood.**

*DR. LOWELL L. WOOD is a senior staff physicist at Lawrence Livermore National Laboratory. He currently leads the Special Projects Program in the Physics Department, and is also a member of the Director's Technical Staff. He received his B.S. in Chemistry and Mathematics from UCLA in 1962, and his Ph.D. in Astrophysics from UCLA in 1965. From 1965-1972, he was employed by Lawrence Livermore National Laboratory as a consultant. His scientific work (done in collaboration with John Nuckolls) culminated in technical proposals leading to the establishment of the national inertial confinement fusion program. During this period, he also worked part-time as Assistant Professor in the Department of Applied Science at UC Davis/Livermore teaching and doing research in the applied physical sciences. He served as Associate Physics Department Head at the Laboratory from 1972-1975, before taking his present position. He is the recipient of numerous awards and honors. In 1981, he received the DOE E.O. Lawrence Award for contributions to National Security.*

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**DR. LOWELL WOOD:** Thank you very much.

The paper that I would like to present to you in overview today is co-authored with two of my Livermore colleagues, Dr. Roderick Hyde and Muriel Ishikawa.

We would like to acknowledge our indebtedness for several very helpful discussions to Danny Hillis, John McCarthy, Marvin Minsky, and very notably, Edward Teller.

What I would like to speak to you about today is the prospect and some of the technical details, and even budgetary and problematic details for getting the United States capable, and exercising that capability to put an expedition on the planet Mars by the end of this century.

Without a sea change in American public opinion, the United States space program will never again enjoy the resource levels - approximately one percent of the GNP - attained by the Apollo Program at its peak. However, the present American technology base for space exploration would require Apollo Program- levels of expenditure for a comparable period in order to execute a manned expedition to Mars, primarily, because our extant space transportation capability is comparable to that which we had in the early 1960s. Only the late-model Titans have no analog in the American launcher inventory, a quarter of a century ago. Because the Congress realizes that operating at 15 to 25 percent of the Apollo Program's pace, which is about what NASA runs at these days, would result in a going-to-Mars program which would accomplish its goal so far into the future as to be of no present interest at all. No such stretched-out program to go to Mars will be commenced.

**Specifically, whether or not manned expeditions to Mars get underway in the foreseeable future will be determined by whether the levels of technical innovation necessary to engender the required overall economies-of-execution have risk levels associated with them which are determined to be acceptable.**

Is Mars thus unattainable, as far as the eye can see? Will featherless bipeds not tread the sands of Mars in our lifetimes, which is the present prospect? To us the answer seems to depend critically on whether risks — programmatic, technical, and human risk — significantly greater than those perceived to have been taken in the Apollo Program, come to be seen as acceptable, and whether higher-risk alternative routes to inner solar systems exploration are seriously considered. Specifically, whether or not manned expeditions to Mars get underway in the foreseeable future will be determined by whether the levels of technical innovation necessary to engender the required overall economies-of-execution have risk levels associated with them which are determined to be acceptable.

In order to provide a substantive starting point for serious discussion of this fundamental point, we present here one such alternative approach. This may not be the lowest risk or the highest benefit-to-risk approach, but it appears to us to be one which features near-term realizability, an attractively low cost and acceptable levels of risk.

As has long been realized, a manned expedition to

Mars - or to any other planet - which proposes to return its explorers to earth is greatly complicated by the requirement to lift its human cargo out of two moderately deep gravity wells, those of the terrestrial and the mission planet surfaces. This requirement stacked on top of the minimum of three major rocket burns necessary to get from the earth to the mission planet and back again, and coupled into the basic rocket equation, seemingly implies that every ton of crew, souvenirs and ship returned to Earth will be associated with a minimum of several thousand tons of mass lifting off the Earth's surface. Since the returned mass apparently must be a minimum of several tons, one is apparently contemplating a launch of at least a half dozen Saturn V-sized vehicles, followed by orbital assembly of their payloads to constitute a single expedition. This is a tall order for our shriveled national space transportation capabilities: we would have to use the entire Space Shuttle fleet for nearly three years to orbit a single mission's components. This is simply not in the cards, at least for the remainder of this century.

The study of where the mass is invested and how it is spent immediately suggests that the Apollo Saturn V upper stage fuel pair of cryogenic hydrogen and oxygen - the propellants also used by the Soviet Energia booster - are strongly advantaged over the more conventional storable propellants employed by Titans and Deltas. The Delta V demands of interplanetary missions are so severe that very high specific impulse propellants are literally exponentially preferred. Compared to light metal, oxygen propellants used in modern solid-fuel rockets, the hydrogen combination offers nearly twice the specific impulse (480 versus 290 seconds), which implies mass ratios more than an order-of-magnitude different for interplanetary lander missions.

Secondly, it becomes clear that hauling propellants up from the Earth's surface is indeed a very expensive way to acquire them. Literally any other propellant point of origin along the entire route is strongly preferable; the terrestrial gravity well is a notably deep one. One is thereby strongly motivated to seek alternative fueling points, even relatively exotic ones.

The moon is known, from analyses of the returned Apollo samples, to be an inexhaustibly large source of premium rocket propellants. Like that of the Earth, the lunar soil is composed of tens of percent of metals with high-enthalpy oxides, and of oxygen itself; moreover, its major components typically contain 0.01% by weight of lightly bound hydrogen gas, most of which can be liberated merely by roasting the soil to temperatures as low as 500 degrees Centigrade. At least as importantly, the moon is perched on the very lip of the terrestrial gravity well, so the rocket propellants picked up there can be used mostly for real interplanetary transfer purposes, rather than expended almost entirely to merely propel some residual fraction out of the grip of the earth's gravity.

If our Mars expedition could somehow pick up its rocket propellant requirements from a point near the moon on its outward bound leg, its lifting-from-Earth mass budget would drop by nearly a hundred-fold. A very daunting weight-lifting requirement would become almost a trivial one; manned exploration of the inner solar system would become something which we could commence in the twentieth century, rather than a challenge left for our grandchildren. But is this even remotely feasible?

This question resolves naturally into three distinct components. First, the hydrogen and oxygen must be won from the lunar soil on the moon's surface. Second, the recovered propellants must be transported to some suitable marshaling point, reasonably close in gravitational potential to that of the lunar surface, so that they aren't all expended in transportation. Third, if reasonably possible, some fraction of the total required propellant mass should be delivered into low earth orbit (LEO) in order to lift the mission's crew and vehicle from LEO to the marshaling point. This offers a savings of about 2.5 in the required weight lifted from the Earth's surface to launch the mission.

Now, the Apollo-retrieved lunar soil samples have been found to contain roughly 100 ppm by weight of lightly bound hydrogen, which is just about the soil's own volume of this gas, if the hydrogen is held at sea-level pressure and room temperature. This hydrogen was apparently ion-implanted into the soil's surface particles, by the high-energy tail of the solar wind. Experiments of these lunar samples have established that the bound hydrogen, which is apparently located in the most superficial micron-deep layers of soil particles, can be liberated by lightly roasting the soil to temperatures of around 500 degrees Centigrade. At least as importantly, typically 300 ppm of water can be liberated by roasting to temperatures less than 1000 degrees Centigrade. Together, these two gases in these quantities provide essentially the ideal hydrogen-oxygen ratio for a maximum specific impulse rocket engine (which requires a super- stoichiometric hydrogen fraction. Also of greater long-term significance for manned exploration of the solar system of the order of 100 ppm each of carbon oxides and nitrogen and nitrogenous compounds are also liberated by such roasting.

An idealized lunar fuel factory would therefore consist of a heat source capable of generating the required heating rates at the necessary temperatures, a means of transporting this heat, and coupling it into a stream of lunar soil, and a means for trapping and storing the hydrogen, water and possibly other gases liberated during this soil roasting.

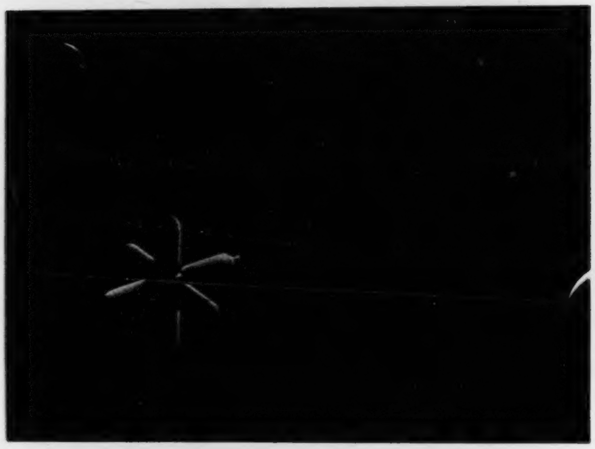
An artist's conception of such a system is shown in Figure 1. This fuel factory generates about a dozen grams/second or roughly one ton per day of hydrogen-oxygen propellants. It thermocatalytically cracks the liberated water, molecular sieve separates the hydrogen

and oxygen gases, mechanically condenses them to cyrogenic liquids and stores them for several hour working periods, and then transfers them to tanks on a nearby propellant ferry-tug which has a quad of four tank pairs each of ten tonnes capacity. Loading each such ferry is thus the work of about six weeks for the fuel factory.

In Figure 1, you see an artist's rendering of one of the ferry-tugs leaving with a full load of propellants while another one, recently arrived, is waiting for a periodic fuel-loading event, roughly a kilometer from the fuel factory's warm working area.

The location to which the propellants are hauled by ferry-tug is largely a matter of choice. We have selected the fourth Lagrangian point of the Earth- Moon system for its favorable position at the upper edge of the terrestrial gravity well, its proximity of both spatial and gravitational terms to the lunar surface, and its orbital stability.

The staging area at L4 is where the interplanetary mission vehicles are fueled as well as the location from which the lunar systems are teleoperated. An artist's conception of the scene here is shown in Figure 2. For both the space station supporting human activity here, and the interplanetary vehicle itself, we have borrowed heavily from the detailed plans of the Columbus Project for a permanent lunar settlement, which we presented at the Second National Space Symposium two and a half years ago. In particular, both make use of inflatable Kevlar-based modules for human habitation, and employ the life-support systems which we discussed in some detail in that paper. The total mass of each of the six modules including their interconnections and external airlocks is about one tonne each so that the system's structural mass is a mere six tons.



Station electrical power is provided by a fuel cell-backed-up solar photovoltaic power, the flexible photovoltaic power generation modules are indicated in the lower right.

The bottom line is that the station furnishings including the crew is 8 tonnes, and the total mass of the staff and functioning station is therefore a mere 14 metric tonnes.

Each of the station's fleets of two ferry-tugs has an empty mass of about 3.7 tonnes. The fleet thus adds 7.4 tons to the total facility's mass budget, plus an additional 2.7 tonnes of initial propellant loading for one of the ferry-tugs to permit it to land for the first time on the lunar surface when the facility goes into operation. The fleet plus fuel depot therefore masses 12 tons in its entirety.

The staging facility at L4 thus has a total mass and emplacement requirement of 26 metric tonnes in order to commence operations. This certainly isn't negligible, but neither is it the largest mass budget for a space station-plus-space ferry system, which has ever been considered.

How might this 26-tonne mass space station be emplaced in high earth orbit? For that matter, how is the ten ton mass of lunar fuel factory to be located on the lunar surface? If RL-10 engined space transport systems are employed, then each of these systems must be launched from low earth orbit (LEO) with about 50 tonnes total mass.

Such payloads could each be launched intact, as total systems, atop the Titan and Delta follow-on vehicles, which have been designed and implementation- scheduled in considerable detail by Martin and by McDonnell Douglas respectively. These very interesting expendable launch vehicles each are capable of launching 110,000 pounds - 50 metric ton payloads - into LEO at recurring costs of $200 million, less than $2,000 per pound, and could do so, the manufacturers have told the government, as soon as 30 months after the "go" order was given.

Yet two other alternatives also reveal some thought. Either the Apollo Saturn V of yesteryear or the Soviet Energia booster of today, could orbit both of these payloads in a single launch!

The Energia option has the immense advantage of requiring an existing booster. The Titan/Delta-derivative ELV option could first put the lunar propellant factory into place, and then emplace the L4 interplanetary staging facility, after the lunar factory had demonstrated its functionality and had propellants for it to dispatch.

All this for a total cost of $400 million.

So now we've emplaced the interplanetary analogs of an oil well and refinery, the lunar facility, and the gas station that would service up its products to the customer vehicle, the L4 staging facility. What does this interplanetary vehicle consist of? What's involved in getting it to the gas station at L4 to fuel up for the Mars trip?

**MASS BUDGET HISTORY**

| Leaving LEO for $L_4$ | Leaving $L_4$ for Mars | Mars Transfer Orbit Insertion | Insert in Mars Orbit; Land on Deimos |
|---|---|---|---|
| 48T Mission payload + mission tankage | 48T Mission payload | 124T Propellant used | 58T Propellant used |
| 78T Propellant + tankage to $L_4$ | 205T Propellant | 120T Payload inserted | 56T Payload landed |
| 126T | 253T | 9T Tankage shed | 4T Tankage shed |
| | | 253T | 2T Consumables used |
| | | | 120T |

| Land On Mars | Mars-Landed Package | Mars Ascent Package | Earth Transfer Orbit Insertion |
|---|---|---|---|
| 4.7T Propellant + tankage used | 1.0T Crew (5) + gear | 1.0T Crew + samples | 12.5 Propellant + tankage used |
| | 1.0T Ascent module | 1.0T Ascent module | |
| (Aerobraking) | 8.0T Ascent module propellant | 8.0T Propellant & tankage | 11.4T Payload inserted |
| | 2.1T Life support gear | 10.0T | -1.4T Consumables used |
| | 1.5T Powerplant | | 10.0T |
| | 2.4T Food (480 d) | | |
| | 3.0T Habitation modules (3) | | |
| | 1.0T Cars (2) | | |
| | 3.6T Misc. gear | | |
| | 4.7T Lander | | |
| | 28.3T | | |

| Earth Return Package |
|---|
| 2.0T Habitation modules (2) |
| 2.1T Life support gear |
| 0.3T Power plant |
| 0.2T Fuel cells |
| 0.4T RL-10 engines |
| 5.0T |
| 1.0T Crew (5) + gear |
| 0.5T Martian samples |
| 3.5T Reentry vehicle |
| 5.0T |
| 10.0T |

TABLE 1

**We want to return a total package mass of ten tonnes to Earth, five tonnes of which gets thrown away just prior to atmospheric re-entry, and five tonnes of which soft-lands, Apollo Return Module style.**

The easy way to answer this question is to determine what has to be returned to Earth at mission's end, and what is to be landed on Mars, at mission's midpoint. After these items and their associated masses are known, everything else comes out just simply by turning the crank on the rocket equation. The choices we've made and the resulting numbers are shown in Table I. We want to return a total package mass of ten tonnes to Earth, five tonnes of which gets thrown away just prior to atmospheric re-entry, and five tonnes of which soft-lands, Apollo Return Module style.

In order to support the needs of the crew on the trip home from Mars, we have to pack 1.4 tonnes of consumables. We therefore have to leave Mars with 11.4 tonnes. I should comment here that it indeed is the case that we do not have the technology demonstrated to support a crew for the multi-year periods that are necessary for missions to Mars. We have therefore invoked for this particular mission planning exercise and its a fairly detailed technical design, only those technologies which have been demonstrated to be reasonably satisfactory for all purposes. We carry to Mars 17.6 tons of systems and materials which we left on the Martian surface as a legacy for the second Mars expedition, which presumably will use their landed mass to support a long duration settlement, leveraged off the basic necessities left by this first expedition. This of course is in the fine tradition of Arctic and Antarctic exploration. We also left our one tonne Mars-to-Deimos ascent module on Deimos. In addition, we had to have two tonnes of consumables for the Earth to Mars trip; half a tonne of propellant tank each ditched in the Mars landing and takeoff, and 14 tonnes more propellant for the Earth-to-Mars, and Mars-to-Earth legs of the trip. A total of 48 tonnes which has to be lifted from the Earth, and fueled up at the L4 station is thus required for this first Mars expedition. The mission fueling requirement which has to be serviced at the L4 station is 205 tonnes, roughly a year's output from the lunar fuel factory via ferry-tug system. The expedition vehicle as it leaves L4 thus masses 253 tons.

Now, a single Titan/Delta derivative follow-up vehicle could insert this 48 tonnes of mission vehicle into LEO. But from whence comes the 78 tonnes of hydrogen-oxygen propellants needed to loft this mission vehicle from LEO to L4? Obviously, it could be sent down from the L4 location, but this is attractive only if atmospheric braking of fuel shipments from the moon into LEO is considered to be feasible. If this doesn't seem to be feasible then another two Titan/Delta- derivative vehicles must be employed, for a total of three required to launch the mission.

But what would all of this cost, and how long would it take to do from the present starting point? What's the bottom line of all these design considerations?

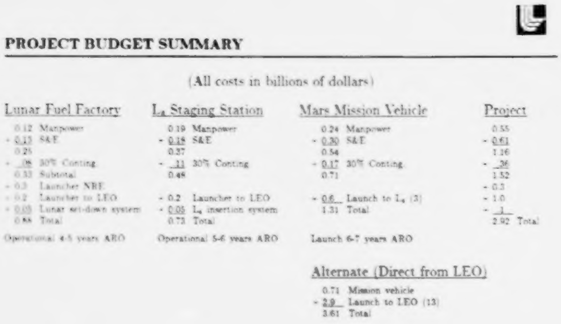
Obviously, if it's done in the traditional bureaucratic setting, Parkinson's Law applies exactly. It will take as long and cost as much as you can possibly afford - and then it may not make it. The questions of real interest address the minimum time and cost which are really required to accomplish this task, in something between the style of NASA in the '60s, and the Manhattan Project in the '40s. Once you have these genuinely minimal numbers, you can then stack on your own choice of time-and- cost multipliers for politics-as-usual, sloth, graft, mediocre management, indifferent staff, legal obstructionism etc. to arrive at your own estimates for the time-and-cost under prevailing circumstances.

We suggest that the 50 tonne launch-to-LEO capability could be created in 2.5 years at a total cost-to-first launch of a half a billion dollars. Subsequent launches would cost two-tenths of a million dollars each. We are merely echoing quite authoritative estimates in this particular area. The total launching cost to send an expedition to Mars - if the lunar fuel factory and the L4 staging station were scrapped entirely, and all the mission propellants were simply launched from the Earth - would be the cost of 13 launches of 50 tonnes each, or $2.9 billion. The advanced ELV launching rate could be such that the mission vehicle could be fully fueled in LEO, ready to go to Mars a half decade from now. To us these seem remarkably small time- and-cost numbers - the more so as they are such relatively firm ones.

**We believe that this expedition could leave the Earth-Moon system six years after serious work on it commenced.**

What then are the likely time-and-cost numbers for the mission vehicle on the ground, and for the lunar fuel factory, and the L4 staging station?

The mission vehicle itself employs Columbus Project technology pervasively, for crew quarters, life support, Martian settlement package modules, power supply, environmental maintenance, structure and propulsion.



**PROJECT BUDGET SUMMARY**

(All costs in billions of dollars)

| Lunar Fuel Factory | $L_4$ Staging Station | Mars Mission Vehicle | Project |
|---|---|---|---|
| 0.12 Manpower | 0.19 Manpower | 0.24 Manpower | 0.55 |
| + 0.13 S&E | + 0.18 S&E | + 0.30 S&E | + 0.61 |
| 0.25 | 0.37 | 0.54 | 1.16 |
| + .08 30% Conting | + .11 30% Conting | + 0.17 30% Conting | + .36 |
| 0.33 Subtotal | 0.48 | 0.71 | 1.52 |
| + 0.3 Launcher NRE | | | + 0.3 |
| + 0.2 Launcher to LEO | + 0.2 Launcher to LEO | + 0.6 Launch to $L_4$ (3) | + 1.0 |
| + 0.05 Lunar set-down system | + 0.05 $L_4$ insertion system | 1.31 Total | + 1 |
| 0.88 Total | 0.73 Total | | 2.92 Total |
| Operational 4-5 years ARO | Operational 5-6 years ARO | Launch 6-7 years ARO | |

Alternate (Direct from LEO)

| | |
|---|---|
| 0.71 | Mission vehicle |
| + 2.9 | Launch to LEO (13) |
| 3.61 | Total |

The bottom lines for the lunar fuel factory, the L4 staging station, and the mission Mars vehicle sum to a $2.9 billion, $0.7 billion to build and launch the L4 staging mission, $0.9 billion to build, launch and emplace the lunar fuel factory, and $1.3 billion to build and launch to L4 the first Mars expeditionary vehicle. We believe that this expedition could leave the Earth-Moon system six years after serious work on it commenced. It would return to earth three years later as indicated in the expedition's master schedule shown in Figure 3.

But why bother with the technical, and thus programmatic risks of the lunar fuel factory and the L4 staging systems? Why not just pay the $3 billion to launch the propellants for the mission vehicle and save the funds otherwise invested in the lunar fuel factory and the staging station?

It seems desirable to us to the point of necessity to abandon our fundamentally frivolous practice of doing-everything-once in space, and then throwing away the means for doing it, or similar things, again later.

The Space Shuttle expressed the right idea, albeit in a politically, programmatically and ultimately technically flawed implementation. In all of America's subsequent major activities in space, we must discipline ourselves to purposefully do base- building to create and then maintain the infrastructure on which future accomplishments can be more quickly and less expensively built. Failure to act on this wisdom - which assuredly didn't originate with us - will continue to induce the near paralysis-of-will which has afflicted the American space enterprise ever since the collapse of the Apollo Program with the reckless abandonment of the Saturn V launcher technology.

**It seems desirable to us to the point of necessity to abandon our fundamentally frivolous practice of doing-everything-once in space, and then throwing away the means for doing it, or similar things, again later.**

The lunar fuel factory and the mission staging space station and high Earth orbit are exemplary of this basic principle. They will be assets of the human race essential to the subsequent rapid and economic manned exploration of the inner solar system. Together, they will enable the subsequent manned expeditions anywhere within the orbit of Jupiter at costs of less than one billion dollars each, and capable of being commenced as often as annually.

Thank you very much.

# INITIATE SPACE AND AVIATION EDUCATION COMPUTER PROGRAM

Featuring Astronaut **James "Ox" van Hoften,** with Sydney, Nebraska teachers and school children
**John Egging**, President, Egging Steel, Gurly, Nebraska,Project Sponsor

**MR. MACLEOD:** While I introduce this unique project, our computer specialists will complete our connection to a group of students and teachers in Sidney, Nebraska who have been standing by for our call. This is to institute a Computernet, which will be a means for the students and teachers there, as a pilot project, to come into the Space and Aviation Education Resource Center at the Foundation by computer, find out about all the materials that are available there, actually read lesson plans if the teachers want to, print them out at their own place, and know how they can use them, and what they can get with them, as far as videos are concerned, and order those. So, it's quite a project. It's starting out right now, as you'll see, and we have Astronaut Ox van Hoften at this end, to talk with the students on the other end.

**MR. HUGHES:** You're now logged onto Spacenet at the Space Foundation. Big Red in Nebraska is on-line. There are 50 school children in a classroom with a single IBM PC dialing in long distance.

**MR. MACLEOD:** This is Central School in Sidney, Nebraska. They are fifth and sixth grade students in the Young Astronauts Program. Their teacher is JoyDeen McCarvell. After taking our workshop here last June, she went back there, and signed up kids for the Young Astronauts program; her initial sign-up was about 160.

**MR. HUGHES:** They have been getting Ox's complete biography during the last speaker on-line in the classroom. They may be reading it very closely. They know every mission that he's been on, how many hours.

**MR. MACLEOD:** The computers and software that we're using were donated by Hewlett-Packard in a $50,600 grant last fall. The capability to hook up this equipment and to establish this Net was provided by the Economic Development Group in Sidney, Nebraska with a grant of $160,000 for 18 months.

**MR. HUGHES** (Pointing to giant screen): There they are. Young Todd O'Connell wants to know what you value most. "What did you value most?"

(Dr. Van Hoften replies.)

**MR. HUGHES:** The kids may be walking up to fire it off, but everything is being captured there. "Here on earth after being in space," Gravis Taylor says, "what does it feel like to" — and he hasn't finished his next line — they didn't do an extra return. The first question was, "What did you value most here on earth after being in space?"

**DR. VAN HOFTEN ANSWERS:** "It's a whole lot of fun."

**MR. HUGHES:** Later, those teachers and the students will be able to dial into Spacenet and not only get lesson plans but ask direct questions of experts in synchronous electronic mail right from their classroom.

> **"What advice would you give a student who wants to be an astronaut?"..."Study very hard and stay in school."**

**MR. MACLEOD:** We will be inviting you, all who use computers, to come on into Spacenet and read the questions that are hanging on there, and if you have expertise in that area, to try to answer. If the pilot experiment works, which we are confident it will, we will then open it up to other areas as they agree to participate. They've got over 50 parents, by the way, also watching this in the school room.

**MR. HUGHES:** As soon as we get voice-to-text with the micro-computer, they could just speak, and we would have it answered on the screen.

"What advice would you give a student who wants to be an astronaut?"

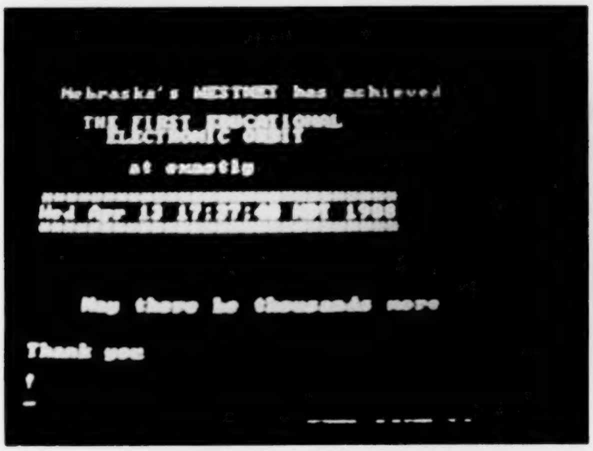
**DR. VAN HOFTEN ANSWERS:** "Study very hard and stay in school."

**MR. MACLEOD:** Is that a worthwhile message to put out around the country?

**MR. HUGHES:** "This is a Spacenet Mission Control. We must launch while the window is open."

Okay. Ox is going to launch it. Hit the launch; start the countdown, 5-4-3-2-1, this is going to their screen, 3-2-1 ignition: Lift off. Spacenet is launched. April 13. May there be thousands more.

Thank you.



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Nebraska's [illegible] has achieved
THE FIRST [illegible]
ELECTRONIC [illegible]
at exactly
[illegible]
May there be thousands more
Thank you
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**MR. MACLEOD:** We've officially launched with the help of Dave Hughes, our consultant on this. Without him, we wouldn't have been able to put it together. At this point, I would like to ask John Egging to come up, and explain what it was that got him to begin this in Sidney, Nebraska.

**MR. EGGING:** Thank you, Dick. You well imagine the excitement in grass roots rural Sidney, Nebraska. I will only take about two minutes of your time. Sidney, Nebraska is located about two hundred miles northeast of Colorado Springs. We are not space technologists in Sidney, Nebraska — yet; however, we are vitally interested in learning what is going on in space. You are the space scientists, technologists, and developers and researchers.

We, in rural Nebraska, have a deep conviction that what you are doing is vitally necessary for our future.

Yesterday, we heard Donald Fink from "Aviation Week" say that there is a need to input space technology into the nation's classrooms. We just saw the launch.

We in Sidney, Nebraska are now doing just that, and in the months ahead, we hope to have a number of additional rural schools in our district, on-line, accessing the SpaceNet technology.

We want to do that so that our young people will have the tools to assist them in their future endeavors.

> **Gene Cernan this noon said we've been singing to the choir too long. We in Sidney would like to learn the lyrics, so that we in rural America can begin to harmonize with you.**

Many have been talking about this for some time. We in Sidney are now doing it.

Hopefully, this effort will help to develop the public constituency that was mentioned yesterday, needed to influence Congress to redevelop the will to win.

Believe me, as our kids learn what space is all about, so will their parents.

Gene Cernan this noon said we've been singing to the choir too long. We in Sidney would like to learn the lyrics, so that we in rural America can begin to harmonize with you.

I invite you to come to our community, and see physically how this is taking place and what is going on.

I want to thank Dick MacLeod, and his Foundation staff for helping get this project launched. Thank you.

**MR. MACLEOD:** Thanks very much, John. John is very modest about all of that. He said he heard a comment made at the last Space Symposium, and "It really challenged me. I think we need to do something about it, and the best way to start is right here at home." They then got the money together and sent seven teachers over to our workshops here, totally funded by the Economic Development business people in that community.

What have the teachers done since they got back? They got those schools turned on. They're using the Young Astronauts program. They are using materials that we provided to them to supplement that, and they really have things moving.

Beyond that, when he gets other businesses coming to town, and they want to hear about what kind of school system they have there, he just has those teachers come out and talk to them, and you won't see or hear a more excited group of people than these teachers telling you as a person visiting, how exciting it is to work in a community where the businessmen are so much behind the educational system; and if it can happen in a rural area of Nebraska, we think it can happen anywhere.

We're delighted to form this partnership with John and the people in Sidney. He was a principal in financing this effort, and getting it really going, and continuing it. We're committed to providing the staffing, the operation of that Spacenet, and we'll add on any of you who would like to help with it.

I'm sure all of you have information that you could share. You can get the entry information from us, and when you find some questions on there, take a little time on it.

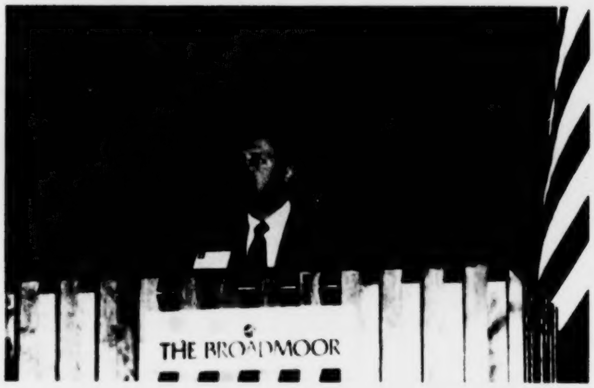
Now, if we are about ready, I would like to run just about a ten-second clip of comments by Jack Anderson, syndicated columnist last year, which specifically caught John Egging's attention. I hope it will catch yours as well. If we're ready, let's roll that Jack Anderson tape.

(Video shown.)

**MR. MACLEOD:** With that let's close our program this afternoon. The refreshments are available in Colorado Hall, and the Space Technology Hall of Fame dinner starts at 7 o'clock.

# Space Technology Hall of Fame Dinner

*MC:*
**Dick MacLeod,** Executive Director, U.S. Space Foundation
*Speaker:*
**Doug Morrow,** Academy Award Winning Writer/ Producer



**MR. MACLEOD:** Good evening ladies and gentlemen, and welcome to the banquet celebrating the first Space Technology Hall of Fame Induction Ceremony.

We're very pleased to have you here with us tonight as we introduce for the first time this concept of a Space Technology Hall of Fame.

Later in the program, we'll be introducing some of the people and hearing about and what they have contributed to this country.

The Fourth National Space Symposium has been off to a good start yesterday and today, with provocative speeches, pro and con arguments, and recognition for those who need it for their contributions to U.S. industry, as well as the U.S. Space Program.

Thank you.

**MR. DAILEY:** Ladies and gentlemen, while you're enjoying your dessert, please enjoy our entertainment, the United States Air Force Academy's Blue Steel.

Ladies and gentlemen, it's my pleasure at this time to pay special recognition to NASA Industry Application Centers. Industry Application Centers are located throughout the country, and they work with industry to identify technological needs and to identify technical problems.

Once identified, the Industry Application Centers search for relevant solutions to those problems by tapping our national resources of information and talent.

Tonight we thank the Industry Applications Center for their significant contribution to tonight's banquet. When asked, would all the IAC directors, or their representatives please stand when I call your name? And please hold your applause until they all have been introduced.

From Aerospace Research Applications Center, Indianapolis Center for Advanced Research, Indianapolis, Indiana, F. Timothy Janis.

From Central Industrial Applications Center, Southeastern Oklahoma State University, Dickie L. Deel.

From the NASA Industrial Applications Center at the University of Pittsburgh, Paul A. McWilliams.

From NASA's Industrial Applications Center at the University of Southern California, Herb Asbury.

From the NASA Southern Technology Applications Center, J. Ronald Thornton.

From the Industrial Applications Center at Southern University, John N. Hubbell.

From NASA's Technology Applications Program at the University of Kentucky, William R. Strong.

From NERAC Incorporated, Tolland, Connecticut, Daniel U. Wilde.

North Carolina Science & Technology Research Center, North Carolina, Hal Payne.

And finally, from the University of New Mexico Technology Applications Center, Stan Morain.

Let's give them a round of applause.

Thanks to you and to your organizations for your support. We really appreciate it.

The next item on our program is the spinoff video. Mr. Morrow has asked me to postpone the video presentation until after the Hall of Fame presentation.

This is the first Space Technology Hall of Fame banquet. It is the intention of the United States Space Foundation and NASA, to continue the tradition starting tonight and to make this banquet a permanent part of the National Space Symposium.

It is also the intention of the United States Space Foundation to house the Hall of Fame award winners in the United States Space Foundation Building when it's completed.

At this time, it is my pleasure to introduce from NASA Headquarters in Washington, the Director of the Division of Technology Utilization, who will present tonight's awards, Mr. Henry Clarks.

**MR. CLARKS:** Thank you. Good evening, ladies and gentlemen. On behalf of NASA, I want to extend our deepest appreciation to the U.S. Space Foundation for inaugurating the Space Technology Hall of Fame, which at this time will recognize individuals and organizations alike who have had a significant role in the development, application and use of space technologies for the public good.

It seems most fitting and proper that the Foundation chose this year to establish the Space Technology Hall of Fame, since this year marks the 25th anniversary of NASA technology and the technology utilization program, a program which has been dedicated to promoting and encouraging the secondary use of NASA developed scientific and engineering advances in industries for commercial use and for society benefits. What better way than to commemorate the 25th anniversary of NASA and the technology utilization program by recognizing the outstanding spinoff achievements which have occurred over that span.

Eight spinoff candidates were nominated for consideration. The nominees were selected from a long and growing list of worthy spinoff candidates. A list of literally thousands of NASA developed technologies, which have entered nearly every facet of our lives from new medical diagnostic tools to new products, and manufacturing processes of almost every description.

The Hall of Fame inductees will be honored tonight, and therefore they are the most significant and those truly representative of the unique value which space technology has offered in our particular economy.

A brief background of how we went through the process: the Space Foundation established a board, a very distinguished board of judges to select the inductees. The panel of judges was comprised of outstanding leaders in government and industry, including the following: The Honorable Jim Wright of Texas, Speaker of the House; the Honorable Robert Byrd, West Virginia, U.S. Senator; the Honorable Jake Garn, U.S. Senator, Majority Leader of the Senate; Congressman Bill Nelson, Florida, Chairman Space & Science Applications Committee; James Beggs, former NASA Administrator and presently Chairman of the Board of Spacehab, Incorporated; Earl Williams, Chairman of the Board, BDM Corporation; David Thompson, President and Chief Executive Officer, Orbital Sciences Corporation; and last but not least, Bill Schnerring, President, Associated Business Publications, and publisher of "NASA Tech Brief Journal."

The Space Technology Hall of Fame awards to be presented tonight are of two types. The first is a plaque which will be presented to each organization which has played a significant role in the technology transport process. That process goes from the NASA field centers, which originally developed the technologies for space purposes, to the companies which have invested their time, energies and resources to the commercial development and use of those technologies, and where applicable, to end users who have significantly spurred acceptance of the spinoff products or processes in the marketplace.

The second award is a Space Foundation certificate, which will be presented to each individual from the participating organizations who has been instrumental in the transport process.

It is now my distinct honor and pleasure to announce the Space Technology Hall of Fame inductees for 1988.

**The first Hall of Fame inductee for 1988 is the Power Factor Controller Frank Nola, the NASA Marshall Space Flight Center.**

**MR. NOLA:** Thank you, Henry.

Our factor controller is an energy-safety device for electric motors that was developed by the Marshall Space Flight Center during the energy shortage in the late '70s. The significance of the device lies in the number of motors to which the device potentially could be applied. It applies to the most common type of motor used, which is the AC inductor motor. That's the type of motor that you have in every major appliance in your home and the type of motor most commonly used by industry. There are 50 million of these motors built each year in the United States, and if you count those used in homes, plus those in industry, there's close to a billion in use every day.

They consume 60 percent of all the electrical energy generated. They use somewhere between 8 and 9 billion barrels of oil equivalent each day. If we could reduce that energy consumption by just an average of 6 percent, we would save about a half a billion barrels of oil a day.

Now, the induction motor's been around since before the turn of the century. It's the workhorse of the world, and that's because it has all the good features that you want in a motor, but it has one inherent flaw in that it needlessly, in many instances, wastes some of the energy that it's consuming.

The reason they waste power is really because of one of its good features: that it can't change its speed. It runs at the same speed whether it's idling or whether it's working hard. A good example of that is an escalator in a department store. That escalator could carry two people on every step all day long, while most of the time it only has one or two people on it, so it's just about idling; and during that time it's receiving the same voltage from the utility company that it would be if it was working hard, so it gets more voltage than it needs. It can't change its speed to regulate its current, so that high voltage forces more current or amperage into the motor than it needs, and causes it to waste power which goes up as heat. What the power factor controller does is it attaches to the leads going to the motor, which is one of the novel features of the device. It doesn't have to see the motor itself. The motor could be in the next room, which means you could apply it to existing motors as well as to new motors, but it attaches to the wires going to the motors, and it senses the relationship between the voltage and the current; and in so doing, it can tell how hard the motor is working. When it senses that the motor does not need the voltage, it automatically reduces the voltage of the motor, which lowers the amperage, and it cuts down on the amount of energy being wasted.

As people start to get on the escalator, it senses that more voltage is needed and automatically increases that voltage to keep the motor operating at an optimum point.

Now one of the other features about the device is that every motor needs a starter, whether it's your washing machine or your dryer, or the escalator — it has to have something that starts and stops that motor. And when the energy-saving device is built in as part of that motor-saving starter, it adds very often, very insignificantly to the cost. The starter in an escalator would typically cost around $1,000 and to add to the energy-saving feature; that would add less than 1 percent of that price. So most manufacturers offer the energy-saving features free of charge in their motor starters.

Let me tell you how we have to get into this at NASA, since we don't have anything to do with industrial-type motors but we do have a lot to do with the motors that run gyroscopes that stabilize our spacecraft. Back in the '70s we were doing some work for the Department of Energy in solar heating and cooling, and we had a house that was both heated and cooled by the sun. It had several motors in it for circulating the water in the air, and each month the engineers had to buy power from the utilities to run those motors and they didn't like it. So they came to us and said, "Can't you guys do something to make these motors take less power?"

Well, we took a look at it and saw what was going on and saw what we could do to it. It didn't really require any new breakthroughs or any new discoveries; it was just a matter of applying aerospace technology to an everyday problem, and that's how we came up with the device.

And if you can measure success by the amount of interest in the device, this has been one of NASA's most successful spinoffs. We received more than 50,000 requests for information on the device. For everybody that requested it, they got a free brochure on the device, which told everything we knew about it, plus it had complete details on how to build the device. And NASA ultimately licensed more than 250 firms, both domestic and foreign, and manufactured the device. And I'm happy to say that several of those firms that have been the most successful in bringing the device to the marketplace are with us tonight, and I will call them up here in just a minute to be recognized.

But first I would like to thank the Foundation for the honor and for the opportunity to tell you about it.

And now, when I call your name, would you please come up?

From Nordic Controls Corporation, Batavia, Illinois, George Halas, Dennis Waltad, Lynn Johnson, and Gilbert Nary.

And accepting on behalf of Nordic is George Halas.

From Harris Corporation in Florida is Robert Pospisil and Clayton Bennett. Accepting on behalf of Harris is Robert Pospisil.

From Chesebrough-Ponds, Inc., Clinton, Connecticut, Richard Johnson.

From the Intellinet Corporation in Suburban Park, Maryland, Dr. Harry Letaw.

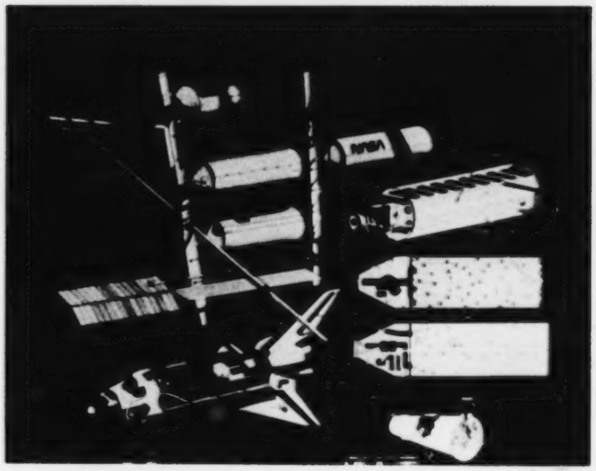
From the Marshall Space Flight Center, Bill Snodds, Deputy Director for Program Development.

Ismail Akbay, our Director of Technology and Utilization Officer.

**MR. CLARKS:** Thank you, Frank Nola. The second Hall of Fame inductee for 1988 is the Sewage Treatment with Water Hyacinths, Dr. B.C. Wolverton, of the National Space Technology Laboratory (NSTL).

**MR. WOLVERTON:** Thank you, Henry.

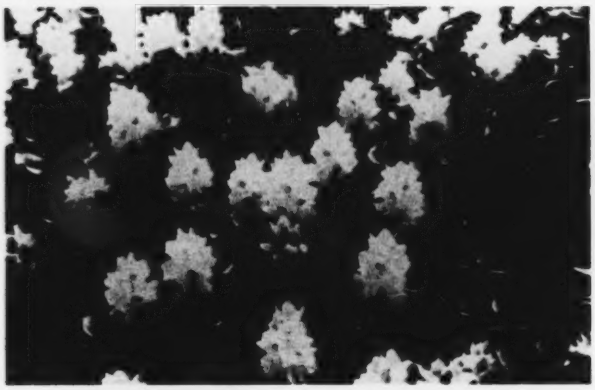
You're probably wondering what sewage has to do with the space program. I would like to spend a few minutes with some slides to convince you that it's a cen-



tral part of the space program. One day I hope that in support of our space travel into deep, deep space, we will use plants and microorganisms to perfect a "little earth" in outer space as our major life-support system.

In the meantime, we are pursuing this technology on earth because of the many environmental problems requiring a simple method to solve.

After about twelve years of research at NSTL, we are looking at possibly using plants in life-support systems in space. We've also applied them to our own wastewater treatment at NSTL. This particular slide is the water hyacinth, the first plant we looked at.



We've cataloged many plants since then. By using plants in a simple hydroponic system to treat our waste, we have saved over the past ten to twelve years, several million dollars. This technology is also being used by a number of small towns throughout the south.

Here's a system at the NSTL that uses another flowering plant, the Canna lily. Also, for single home systems in rural areas where they do not have a central system, this system is being applied in conjunction with a septic tank to produce a flower garden to treat their waste as shown in this slide. This is a natural system.

Another system in a small town in North Louisiana with a population of about 2,500, has changed from a mechanical system, which they could not afford, to a simple flower-garden type system. They have since reduced their sewage bill by 25 percent which is unheard of in this day and time, with prices going up.

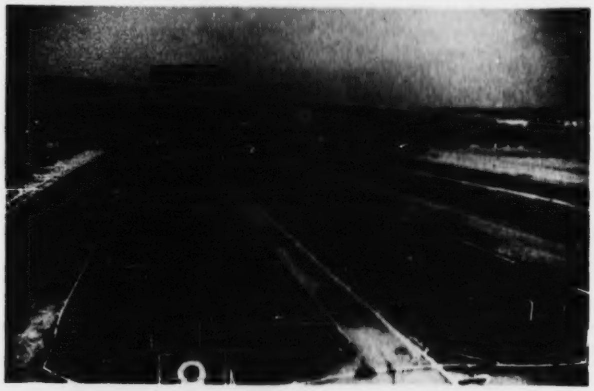
This is another system in Louisiana, at the public health center, the old leprosy colony, and again, it uses plants. But if you'll notice, these are different type marsh plants and they're flowering plants also. Here's what the water looks like as it goes through this system. As you can see, it looks pretty nice. So maybe it won't be too bad in the space station to have to drink that.

Here is another system that is quite different. It's a large industrial complex. Most of the systems we're dealing with now are domestic sewage. But industries are beginning to accept this as a means of treating organic waste. This is a large chemical plant near Mobile, Alabama that dumps their waste into the Mobile Bay.

This is the first large industrial complex to use this technology.

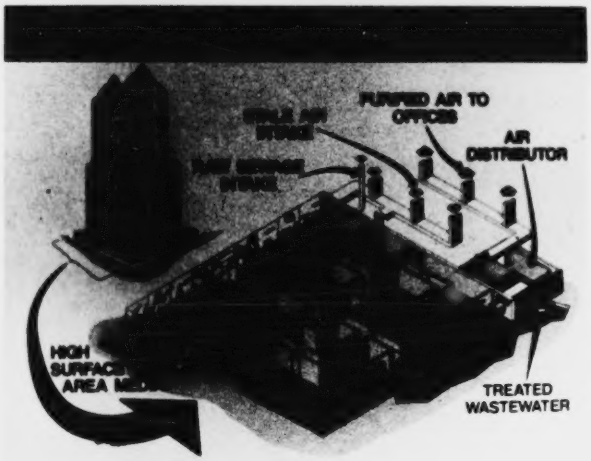
This particular plant is an aquatic plant called a bulrush. We have a whole variety of plants over the years that we've cataloged, starting with the water hyacinth.

One of the most sophisticated systems that we've been involved with is in the State of California, and this has been going on for ten years. As those of you from Southern California are aware, water is a problem. 90 percent of the water is imported to Southern California. In an effort to come up with a new source of fresh water, this is one of several options they're looking at in recycling and reusing wastewater. So again, we are using water hyacinths. This system, presently a pilot system, treats about a half million gallons, per day. Recently 50,000 gallon per day have started coming on line as potable water. There will be a three-year epidemiology study to evaluate this water compared with the present drinking water. So you can see that what California is doing today, on a pilot scale, is what we hope to do maybe in 10, 15, 20 years in space.



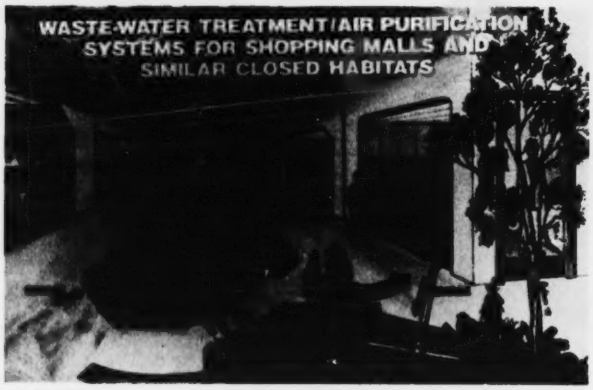
They are also looking at using this biomass plant material to convert it into energy or fertilizer. So it's called a total resource recovery system.

Now as we look beyond that, we're also looking at using plants and nature in cleaning the indoor-air problem that's beginning to evolve; the problem of radon and formaldehyde. This is a concept, using technology now available, to take large buildings like these, completely enclose them, as we will one day hopefully do in a space station, and produce a closed environment.



Here's another concept of a model, and this could be a station on the moon or some other planet, where we create a "little earth" in outer space.

Some of you may be aware, there is a two-acre system, called Biosphere II, in Arizona that they're look-

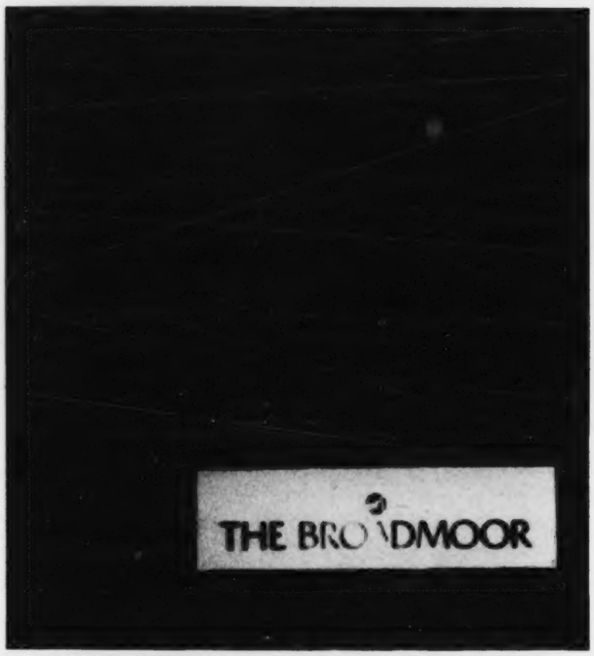

WASTE-WATER TREATMENT/AIR PURIFICATION
SYSTEMS FOR SHOPPING MALLS AND
SIMILAR CLOSED HABITATS

ing at enclosing. This technology has in the past twelve years come from being somewhat of a novelty, to a reality. Now there are over 40 systems throughout Alabama, Mississippi and Louisiana using plants to treat waste. The waste is the hydroponic solution that feeds the plants. This process of treating wastewater is very simple, cost effective and easy to maintain, and, in most cases, there are no moving parts. When you have gravity feed, there are no motors. It's so simple, people scratch their heads and say, just in awe, it's not real. But I think you will see in the next few years the amazement of what is evolving from the space program into using natural biological processes for treating waste and purifying air. I do want to thank all the people involved in giving me this honor of being one of the first inductees into this Hall of Fame. I'm very grateful.

Now I would like to ask, on behalf of the Water Control Resources Board of the State of California, that Cecil Martin come up and accept the award for the State of California.

On behalf of the Space Technology Laboratories, I would like to ask Mr. Roy Estes, our deputy director and one of my many bosses, if he would come up and accept the award for NSTL.

**MR. CLARKS:** The third Hall of Fame inductee for 1988 is the Improved Firefighters' Breathing Systems, Pat McLaughlin, NASA Johnson Space Center.



**MR. MC LAUGHLAN:** The NASA firefighters Breathing System Program is an example of a successful aerospace to commercial technology transfer. I'd first like for you to picture a firefighter's job — a multi-story brick tenement with smoke and fire showing at each window — victims possibly trapped inside. How would you like that for your afternoon job? It's a firefighter's job and it's a tough job, and we tried to make their job easier and more efficient through NASA's Firefighters' Breathing System Program. Our prototype breathing systems illustrates the use of a higher pressure composite fiber mound pressure vessel which is the key weight and bulk reduction. I'd like to discuss how we accomplish the technology transfer process rather than concentrating on the technical details. I think it's the technology process that's really interesting in this situation. How did NASA get involved in this? Well, the Boston Fire Department originated a request for NASA's help. Basically, they said, that although astronauts breathe and work effectively in space; firefighter's are still burdened by inefficient respiratory protection. They ask what can NASA do to help firemen in terms of their respiratory protective needs?

We know that respiratory protection is mandatory. We must have it to allow the firemen to conduct an interior fire attack or rescue. We also know that all our new synthetics produce extremely toxic gases. Through our cities every day, many cargos of hazardous materials are transported and are subject to accidental spills. Efficient breathing apparatus is a key requirement for those involved in control of hazardous materials.

The NASA Johnson Space Center was asked to technically manage this program to utilized our prior space suit and portable life support system experience.

Let's talk about some of the objectives of the program. Certainly, we wanted to satisfy the fire department requirements to achieve use acceptance. But, even more importantly we had to achieve commercial availability. Without commercialization of the technology this technology transfer process is really for nought. But what are the obstacles? Yes, there are obstacles to technology transfer.

No System Integration. In the firefighter's world, there was no coordinator to establish system goals. There were manufacturers, firefighters, city governments, and regulatory agencies. Each had their individual role but there was systems integration to establish a united technology objective.

Industry Traditions. The manufacturers were well established with their traditional share of the market and lacked incentive for technology advances.

Regulatory Requirements. The various federal regulatory agencies established protective equipment requirements which were primarily based on existing technology at the time regulations were established. Manufacturers were reluctant to force new requirements or new products into the regulatory approval process.

Profit Potential. Anyone planning to introduce new technology into an established market must be concerned with the economic return. The firefighters' market is very diverse compounding the economic uncertainty.

How did we overcome obstacles and satisfy our objectives? We established a requirements advisory panel—firefighters, fire department management, mayors, city managers, union representatives, regulatory representatives, manufacturers — to define a unified set of goals. We then applied some good NASA systems engineering to put together a total system specification.

We also engaged in some modest "Pump priming," by funding a portion of the development costs. We worked with the regulatory agencies to provide interim approval for prototypes; and we accomplished a field performance verification of our prototype hardware in actual firefighting application.

Specifically what was the technology that we utilized here? Probably the most significant new technology item that we forced into the commercial market was composite pressure vessels. We were able to reduce the weight of the breathing apparatus by about 50 percent utilizing the filament wrapped aluminum lined pressure vessels. Also, bulk, the physical size of the breathing apparatus, was a problem for the firefighters. We reduced bulk by storing compressed air at twice the conventional pressure. New regulator technology resulted in better breathing air flow. Human factors analysis produced improved donning and carrying and system integration to pull diverse objectives together for a common goal.

What were our results? As part of our program, we manufactured 20 prototypes. We put those prototypes out into actual firefighting use — Houston, Los Angeles, New York — they worked well. The regulatory agencies were very cooperative in modifying their approval standards for compatibility with new technology. We achieved significant commercial production. An example is "Structural Composites Industries." They are now a major producer of light-weight fiber wound composite pressure vessels for multiple applications.

Scott is the dominant producer of the new technology breathing apparatus.

The transfer of technology to the commercial market place has resulted in markets, expanded product lines and improved profit potential. The producers are happy. The users are also happy.

I treasure a photo of a fire scene, a brick four-story tenement fire showing. Three firefighters are in the foreground, donning their NASA technology firefighters Breathing System. The new technology breathing systems are commonplace today.

It was a productive program, and I thank you for the Space Hall of Fame honor.

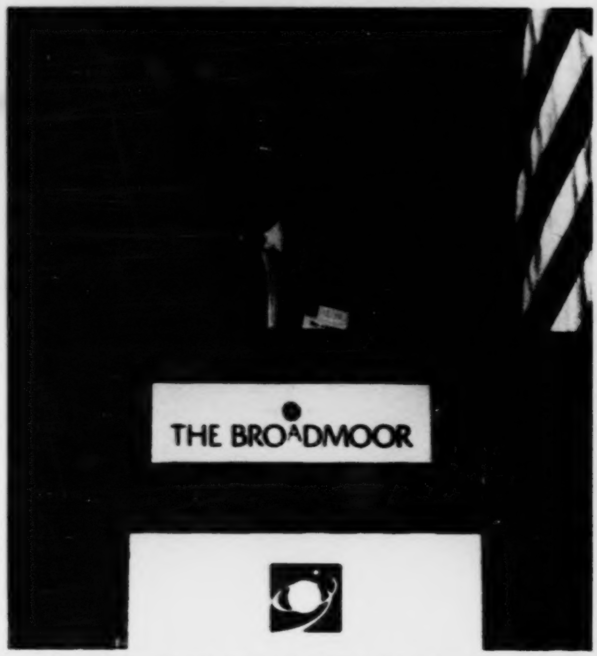
For some additional awards on the improved firefighters' breathing system, accepting on behalf of the United States Fire Administration, we have Tom Smith.

And accepting on behalf of the Johnson Space Center, Mr. Dean Glenn, our Technology Utilization Officer at the Johnson Center.

These were only some of the very vital and valuable people involved in this program. This program cut across many, many segments of our economic society.

Thank you.

**MR. CLARKS:** The fourth and fifth Hall of Fame inductee for 1988 is the Goddard Space Flight Center, Don S. Friedman, NASTRAN Software & the Programmable Implantable Medication System.



**MR. FRIEDMAN:** The NASTRAN Analysis Computer Program was developed in the 1960s by a team comprised of the Computer Science Corporation, the McNeal Schwinn Corporation, and the Martin Company under contract to the NASTRAN Project Office at Goddard.

NASTRAN was originally developed to help design aircraft, spacecraft and large structures. NASTRAN's development provided the NASA Research Centers with a powerful general purpose, finite element computer program for structural analysis.

The system has become widely accepted as a standard in the structural analysis community. The intended range of applications of NASTRAN includes almost every kind of structure and construction.

Non-aerospace industrial users have reported hundreds and hundreds of different applications and multimillion dollar savings attributable to NASTRAN's use.

It has been used in designs from chicken wire to bridges, automobiles, sports stadiums, skyscrapers, railroad tracks, freight cars; the list goes on and on. As recently as last year, Cosmic issued 120 licenses to potential NASTRAN users.

Large United States corporations, such as IBM, Rockwell, Texas Instruments, Boeing, General Motors, Eastman Kodak, Babcock and Wilcox, lead a long list of companies which have found NASTRAN to be an indispensable computer design tool for industry. It is considered to be the most significant advancement in structural design and analysis available in recent times.

The NASA-sponsored Computer Software Management and Information Center known as Cosmic at the University of Georgia leases NASTRAN, as well as other aerospace-developed computer programs, to industrial firms for application use.

At this time, I would like to recognize three of those licensees, if they would come up as their names are called, please.

Mr. John Sherrer, of Texas Instruments.

Mr. Wang, of IBM Corporation Research Center, Yorktown Heights, New York.

And Mr. Sam Iacobellis, of Rockwell International Corporation in El Segundo, California.

It's a great honor to be recognized by an organization like the Space Foundation for one award. To get two awards for the Goddard Space Flight Center is really, in my opinion, very outstanding, and we certainly, on behalf of Dr. Townsend and the Goddard Space Flight Center, appreciate the recognition. It's very exciting to take a technology that was originally designed for one application and be able to apply it to a secondary application.

The next project that I want to describe really is an outstanding example of a technology transfer process.

The technologies that we have developed in our space activities have led to a family of medical devices that are implantable. We like to call it from outer space to inner space. The Goddard Space Flight Center has been working in collaboration with the Applied Physics Laboratory of the Johns Hopkins University for the past 25 years in the development of scientific satellites and experiments.

Out of that collaboration has come a program called the Programmable Implantable Medication System. This really is a marvel in engineering. I always think it's a spacecraft without a propulsion system. It has in it the battery advances, the miniaturized circuitry, the digital telemetry and electronics sensing system that we need to do our spacecraft work.

It's a new medication system, and it's designed to automatically inject medication, such as insulin, to target organs of the body. The Programmable Implantable Medication System, known as PIMS, was a product of a joint program between NASA, the Johns Hopkins Applied Physics Laboratory, and our industrial partners headed by MiniMed Technologies and the Parker Hannifan Corporation.

PIMS is about the size of a woman's compact and contains a reservoir of medication, a battery, all necessary electronics, including an on-board computer to regulate the patient's prescriptive needs, a catheter leading to the target organ and a tiny pump capable of delivering controlled doses of medication, as small as one millionth of a liter at a time.

The action of a medication system can be prescribed by a physician to meet the specific needs of the patients through a telemetry system similar to those used by NASA to control the attitude of spacecraft.

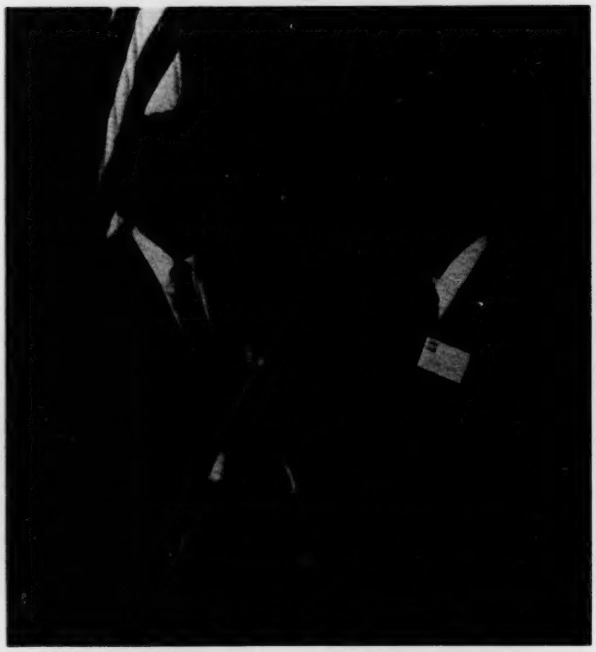
The miniaturized pump and associated valve are key components of the device and are a direct spinoff of the biological laboratory developed for the Viking Space Probe that landed on Mars.

Each patient has his own internal control system to be able to program the PIMS as prescribed medication is needed.

After approximately three months, when it is used for insulin, the insulin is then refilled in the doctor's office, or at an appropriate location through the skin and through the septum, and the patient then goes back to his normal way of doing business.

Currently, the PIMS is undergoing tests and evaluations. We started the project in 1979; the first implant was in 1986. NASA put in about $2 million. Industry put in about $15 million. And I really think that's a great example of working with our industrial partners and leveraging our money.

I would now like to recognize two individuals who are out in the audience. Without their help and their sponsorship and their leadership, the PIMS would have never have been successful.



Accepting the award for the Johns Hopkins Applied Physics Laboratory is the inventor, the father, and really the founder of PIMS, Bob Fischell.

I would now like to recognize Al Mann, Chief Executive Officer and founder of the Mini Medical Technology Corporation. Without Al's risk taking, without his sponsorship, and without his belief in the program, PIMS would not be in those 17 people now undergoing Food and Drug Administration evaluation.

Again, on behalf of Goddard, we thank the Space Foundation for these awards.

**MR. CLARKS:** As I mentioned earlier, we started out with eight nominees and we had five inductees. I would like, at this time, to recognize the transfer of the technologies, which were invented and spun off to the marketplace, but which did not receive an award this evening. The Fabric Dome project of the Johnson Space Flight Center, Black & Decker's cordless tools, and the scratch-resistant sunglasses, for which technologies were developed by the Ames Research Center.

This closes my remarks for now, and I really appreciate your attention. In recognition of the team of people who have basically made a strong contribution to what we are celebrating tonight, I would like to receive a strong show of hands.

**MR. DAILEY:** At this point we would like to show you the spinoff video presentation, as an introduction to our special guest speaker. The video tape highlights the U.S. Space Program's spinoff public service campaign.

The campaign featured celebrities of differing backgrounds who share a common focus, that of a vigorous U.S. Space Program with tangible benefits for all. Please watch our tape.

(Video shown.)

**MR. MACLEOD:** Who would have thought of something like that? What kind of imagination would have produced a series that would have as many quips, as many good pairings as we've seen here tonight? Several of those are showing now on national television, and about two weeks ago they were released as radio ads narrated by Hugh Downs. You will hear on the radio "This is Hugh Downs speaking for the United States Space Foundation," and then going into the ads that you've just seen.

The guy who did that came up with the idea, went out and found the support for it, came to the U.S. Space Foundation and said, "I've got a program in mind; I would like you to work with us and see what we could do. What do you think of the idea?"

And Gen. Hill told him, "Let's do it."

Our board all looked at it, and said, "This sounds like a great one," and I think you will agree, it turned out to be a great one. The man who did this is an Academy award-winning writer and producer from Hollywood, who has done some interesting things during his life. Most recently, at the age of 71, he climbed up to about 22,000 feet on Mt. Everest **without oxygen;** has tried to be prepared to go out into space, and probably would have been ready to fly, had it not been for the Challenger tragedy.

I would like, without further ado, to ask the gentleman who produced these to come up here and tell us a few of the anecdotes that went along with bringing these unique celebrity pairs together, and how it all came about.

Ladies and gentlemen, the star of our Foundation right now, Doug Morrow.

**MR. MORROW:** Thank you. I have to tell you that Dick has laid one on you this evening. For the past two days, and for the next two days, you will have heard from real experts, people who just overawe me with their knowledge and their expertise.

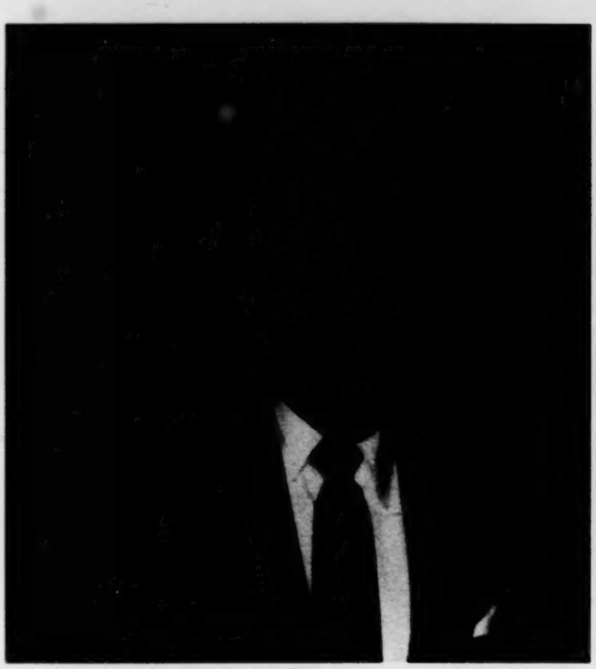
You're not getting that tonight. I am no expert. I am no scientist. I'm no engineer — well, to give you an idea, when I lie down on the sofa in my study and push a button on a thing the size of a pack of cigarettes, and some guy appears on the screen across the room in color and starts talking to me... every time, I say, "Damn, how do they do that?" I still don't know, but I know they do it. And that's important, and I will try to tell you why.

First, let me give you just a little background on how this came about, which will lead me to tell you about a discovery that I made in the course of doing all this. And it may be quite important, particularly in terms of some of the stuff we've heard the last two days, all of which was true, and with which I have no argument.

Shortly before the Challenger accident, I had an amorphous feeling that there was something wrong with the space program.

I was moderately well informed about it, as any layperson would be who follows the news, but I didn't really know very much about it. In the course of a conversation with the President on some other matters one day, I casually mentioned this vague concern that I had and, to my surprise, he said, "You know, I have been feeling the same thing. What is troubling you?"

I said, "I think that the problem is that" — at this time, you must remember, the shuttles were going back and forth regularly — "that the public may be taking it for granted, and that the very success of the program in a subliminal way may be working to its disadvantage."



*DOUG MORROW, creator/producer of the Public Service Series, "Space Technology ... This Is What's In It For You," is an award-winning member of the motion picture and advertising business. He currently serves as a member of the NASA Advisory Council and has been honored both by NASA and the Congress for his contributions to the United States Space Effort. Morrow became involved with the U.S. Space Program after reaching over 21,000 feet on Mount Everest without using oxygen, at age 71. Morrow attended Columbia and New York Universities, and holds a Bachelor's degree in Political Science, a Bachelor of Laws, and a Master of Laws.*

**"I think that the problem is that ...the public may be taking it for granted, and that the very success of the program in a subliminal way may be working to its disadvantage."**

To my surprise he agreed and said, "I think that is possible. Is there anything we can do about it?"

I didn't have any idea.

He said, "Why don't you look into it?"

He got me together with Jim Beggs, and I spent six and a half months of the most intensive study I've ever gone through and, in the course of that, I ran into the spinoffs.

Now, I think I'm normally well informed, as most people are who follow the news. But I didn't have a clue about this stuff.

It boggled my mind and, in a subsequent meeting with the President, I told him about the spinoffs and he said, "Oh, I'm sure there's some good stuff coming out of it."

It is no discredit to him that he didn't know the specifics. I had not known, and you would be surprised at some of the people, whom I will not name, who have not known about these spinoffs. It is one of the few — and I underscore **few** — real failures of NASA.

They were totally concerned with their job, which they have done magnificently, the Challenger accident notwithstanding. To me, their record has been incredible. They made mistakes, you bet they have, but find me someone who hasn't. We are all human. The agency, and all of its operations, are run by human beings, and a human error is unavoidable sometimes, as tragic as it might be. But their overall record has been superb.

I described some of the spinoffs to the President, and told him that I would like to try to do something to let the public know about them. Afterall, they're paying for this. He asked me how I'd like to do it. I told him that we should try to cover the entire spectrum of the society, male, female, black, white, liberal, conservative, Democrat, Republican, because these benefits are like the sun shining. It shines on everybody.

He said "That sounds great, but this must be pure pro bono. It should not be a government project or a NASA project. Have you any clue as to how you would like to go about it?" And I told him that I was dreaming of some of these weird teams.

Well, I guess he thought I was smoking funny cigarettes when I came up with Gloria Steinem and Charlton Heston, and Barry Goldwater with Jesse Jackson, and Tip O'Neill with Bill Buckley, etc. But he told me to take a shot at it.

The first problem was financing the project. So I made up a list of companies, and very deliberately chose more non-space companies than space. My goal was to have a consortium of companies of which 50 percent more would be non-space than space, so that there would be no perception of the space industry beating its own drum and blowing its own trumpet.

And this is when my educational process began to develop.

Within three and a half weeks, I had raised more than my target, which was in seven figures. And the non-space companies were immediately responsive. I knew that the space companies would be, they had an ax to grind, but some of these non-space companies had no relationship to space. They were responding out of a sense of awareness of what the program means, even though they didn't have a clue about these spinoffs until I told them about them.

So we had the funding, and I now went about trying to get these celebrities together.

My educational process went a step further.

I was astounded to find that, as I mentioned earlier, Gloria Steinem was willing to participate in this, and with Charlton Heston. Now, I hope you will all realize what this means. They are diametric. To her, he is the ultimate conservative male chauvinist pig, and whatever the obverse of that is, that's what she is to him.

We expected bloodshed, but we went ahead.

I next approached Bill Buckley and told him about the idea. He said he would love to do it, and I said, "Before you commit, I would like to team you with Tip O'Neill."

He said, "I beg your pardon?"

I said, "I would like to team you with Tip O'Neill."

He said, "Good Lord, a marriage made in heaven. How does Tip feel about it?"

I said, "I haven't asked him yet."

He said, "Well, you tell Tip if he's willing to do it with me, I would be delighted to do it with him."

I called Tip. Same thing. When I mentioned Bill Buckley...hello, hello, same thing. He said, "If he's willing to do it..." Same thing, with Barry Goldwater and Jesse Jackson, and with Helen Hayes and Whoopi Goldberg. What I wanted was the old guard which Lord knows Helen Hayes is at 87 years. A conservative lady, and a great devotee of the President. Whoopi, as you all know, is a very active liberal, and certainly the new wave.

I won't go into all the teams, I don't want to take too much time, because I want to get to my discovery.

These people went the extra mile beyond anything I could have hoped. Just to give you an example, getting them together was almost impossible. They live in different parts of the world, all incredibly busy, and we had to get them together, to team them for the shooting.

I discovered that Whoopi Goldberg will not fly. She had witnessed an airplane accident as a child, and she's absolutely pathological about it.

Helen Hayes is 87 years old. I called Helen and said, "I don't know how we're going to do this, because Whoopi won't fly."

"Why not?" I told her the reason. She said, "That poor girl. Well, I will come to California," this from an 87-year-old woman.

I said, "Helen, I don't want you do that."

She said, "I don't have the problem. She does." And she got on an airplane and came out.

Now, you must keep in mind none of these people need publicity. They have all made it. God knows they weren't getting paid.

Why were they doing it and teaming up with their ideological adversaries, so to speak? Take Barry Goldwater.

He, as you know, had new hips some time ago, and then in April had a new knee put in. He is really the bionic man. I said, "We'll come down to Arizona."

He said, "You can't do that. The Reverend is running for President, and he can't come down here. He's not going to get any votes down here. He's got to go where the votes are. As soon as they hand me a crutch, you tell me where to be." And he came up to Washington, where Jackson had his headquarters at that time, which I thought was remarkable.

Again, little lights were going on in my head. In the distance I could hear trumpets but I didn't know what they were.

A funny thing happened. It's irrelevant but it might amuse you. I picked up Barry, and then we were going to pick up Jesse and go out to Alexandria to shoot. We are in the car, just going along. Suddenly Barry turned and said, "Jesse" — now, this was in May of last year, long before the primaries or the caucuses — he said "Jesse, how do you like running for President?"

And Jesse said, "Well, it sure beats pickin' cotton."

Well, we almost drove off the road. My driver went bananas and we broke up. With the timing of Jack Benny — and get the significance of this — when the laugh died, Jesse said, "'Stead of pickin' cotton, I'm pickin' presidents."

Well, he may not have been wrong, the way things are going on his side of the political fence.

I watched these people and I think you will agree, they cover our societal spectrum. Itzhak Perlman, possibly the greatest violinist of our time; Ray Charles, jazz master; the jocks: Kareem Abdul Jabbar, Bill Shoemaker, John Madden. There was a community of purpose that was beginning to get to me, and I still couldn't put my finger on it. And then it came to me, and I must tell you a little personal incident that is terribly significant and ties in with what we're talking about these four days here in Colorado Springs.

The most successful person that I have ever known, and I have known a few, is my housekeeper. She is — barely literate would be an exaggeration. She can manage to scratch out a little note to me, but I have to decipher it, and I have to be very careful if I leave a note for her. She may be the most successful person I've known because she had two children and got her son into the state university in California. In his senior year, he was adopted by a major corporation which financed his graduate work in electrical engineering.

Her daughter, a few years younger, had the same thing happen to her. In her senior year, was adopted by a major bank, which financed her graduate work in finance, and who is now in a middle level executive position in a major bank.

That mother is a successful woman.

And she was the trigger, the message, I want to bring you tonight.

I was just starting breakfast one morning, and the phone started and there was a problem. I've forgotten what it was, but it had to do with the space program, because by now I was up to my ears in space, and there was some problem which went back and forth on the phone. She was outraged because she couldn't serve breakfast.

**How long they gonna keep messing around? Where else we gonna go?"**

I finally got off the phone, talking to myself, and she said, "Are you still mixed up in that space thing?"

And I said, "I'm afraid so." She shook her head and grumbled. I said, "What's the matter?"

Now, she needed a moment to put her thoughts together. She covered it by pouring me some coffee, just shaking her head, and then she uttered a deathless sentence. "How long they gonna keep messing around? Where else we gonna go?"

Think about it. This woman, who knows nothing about budget committees hit what I think is the key to our situation today. The translation of what she said was, "Why are they delaying? Why are they fooling around? We are going into space. Where else are they going to go? There is no other choice."

**We are *in* the space age. We hear the phrase "the dawn of the space age." The dawn is over. The sun is *up*. It's happening.**

And what I have found in the past year, year and a half, is something that contradicts several things that have been said at this Symposium and that have been said in other places. Jim Beggs, for whom I have utmost affection and regard, said something about our needing a constituency. You've heard that. We keep talking about the new frontier. But it's not a new frontier anymore.

We are **in** the space age. We hear the phrase "the dawn of the space age." The dawn is over. The sun is **up**. It's happening. And what I have discovered is that we have the damnedest constituency we could ever want, the American public. Joe Six-pack and Suzie Six-pack are ahead of the Administration, they're ahead of the Congress, they are ahead of all of us.

They instinctively have recognized that we are going to move forward into space. They may not be experts in history, but instinctively they know what is a fact, that for the 5 or 10,000 years of man's more advanced state, man has always moved forward.

There have been a few delays, there have been a few brief pauses, but the movement has always been forward and they know it. They know we're in the space age and are assuming and relying upon us, who are supposed to have the expertise, to take them into the space age for the benefit of all of us. And when she said, "Why are they messing around? Where else are they going to go?"...she put it in a nutshell.

So what I'm saying to you tonight is...forget this business about do we have a constituency. We have it. Every poll — and reference has been made to this — has indicated that public support ranges somewhere from 70 to 80 percent. There will always be a small percentage who, if for no reason other than just inherent orneriness, will combat progress. But, overwhelmingly, that constituency is out there expecting that we will do the right thing. And I am convinced beyond any rebuttal that if the Administration whichever it is, the present one, the next one, the one after that — or the Congress, whether it's a Republican Congress or a Democratic Congress or a mixed bag...if they don't deliver the goods, they will hear from this vast constituency.

Now, we do have one obligation, and that is to continue to remind our people — hopefully this series and some of the other things that we're planning, will do that — to remind them of what is being done, to let them know that their instinctive hopes — their dreams — are in the process of being fulfilled. At NASA, presently, we are constructing a follow-up to this series which, hopefully, by the way, will go on into 1989. As it reaches its final phase, we hope to phase in a new program to continue this dissemination of information and remind our constituency that this is an ongoing thing.

We don't have to develop this constituency. It's there.

Our obligation is not to let them down. Because if we do, at some point, you're going to hear from them. And whatever administration it is, whatever Congress it is, will deserve what it gets.

Challenger was an accident. Whether it was due to human failure or human mistake is almost irrelevant. It was an accident. Nobody sat down and said let's see how we can blow up this vehicle. But if any administration, or any Congress, in its **deliberations,** sidetracks or derails the American Space Program, it will not have been an accident. It will have been deliberate. And it is important that we, through this constituency, remind those who hold the reins...the Administration, whichever it is, and the Congress...that they are beholden to this constituency, at their political risk.

So if there's anything that you, the experts, can do to maintain that pressure and maintain that understanding, accept as a fact that the constituency is there and work on their behalf to see that they get, not only what they deserve, but what, believe me, they expect.

I thank you, and I appreciate your patience sitting through this, and I wish you all well.

Thank you.

**MR. MACLEOD:** A great mind, a great gentleman. Doug Morrow, as you've just heard, has not only had great ideas, not only great persuasion in getting them financed and convincing disparate groups of people to work together, but he is a very observant gentleman as well, and I would suggest to you that, as we, at the U.S. Space Foundation, have worked with this particular campaign and with others including this Symposium, now, for the fourth year in a row, you have seen demonstrated that with a lot of hard work, reasonably smart hard work, we can succeed in making an impression, bringing to the surface those latent thoughts, that many people in this country have in support of the U.S. Space program. And let's face it, it's not something people think about every day. It's not something that they write to their Congressmen about. It's not something that's in their pocketbook, if you will, as an economic issue. But it is something in which the American people feel a real pride.

When we see our astronauts seated here in this audience tonight, when we recognize what they have done, what they've risked and what they've accomplished, and we recognize also the anguish they feel as to what has not happened since many of them were successful in their flights, we then recognize that there is a constituency, but it needs to be brought to the surface, it needs to be awakened and there are ways to do that.

We hope to be a part of them.

I want to thank our staff here for the work they've done in bringing together from a concept described to them only a matter of weeks ago to what you see here tonight as the First Space Technology Hall of Fame Dinner and Induction Ceremony, and those in NASA, Henry Clarks, who had the vision to pick up on an idea, and a tremendously hard-working Len Ault who works with Henry, who, no matter what it was or what it took over the last few weeks managed to come up with the answers, find the detail and help us get through all of these actions that were necessary to get these selections made.

You can be proud of the people in our Space Program, and you can be proud of the people in your U.S. Space Foundation.

As you leave tonight, you're going to be given a new Special Report, on the U.S. Space Foundation.

There are many of us in the room tonight who are wearing this pin. It was designed right here in Colorado Springs by Current/Looart, Gary and Dusty Loo, when they were owners there, jumping right in and helping us out right at the beginning of the Foundation.

We hope that we'll see that pin on the lapels of nearly everybody we meet, particularly in Colorado Springs where our national headquarters is located, but also around the country. We'll work with every organization in this country now working in any way, in **any way** on the subject of space and what it means to us.

We mean that. And as I said to someone earlier tonight, if some of them are too stiff, too eager to protect what they may think they may have started or done, we'll overwhelm them with generosity and cooperation and get together.

I hope that you have enjoyed your get-together tonight. I thank our board members and our friends for being here, and thank you for concentrating just this moment in time on the U.S. Space Program. Thank you and good night.

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U.S. SPACE FOUNDATION

# MILITARY SPACE IMPERATIVES

*Moderator:* **Bill Hybl,** President,
U.S. Space Foundation

*Keynote:*
The Honorable **Edward C. "Pete" Aldridge,**
Secretary of the Air Force

**MR. MACLEOD:** Good morning, ladies and gentlemen, and welcome to this, our third day of the Fourth National Space Symposium. We have an outstanding group of panelists and speakers, who are going to set the stage factually with what is going on right now, as well as to provide their opinions, their judgments and be open to your questions.

To start the program today, I will introduce the President of the U.S. Space Foundation, a gentleman who is very well known here in the area. He is the president of the El Pomar Foundation.

He's a member of the National Board of the U.S. Chamber of Commerce and he's known as a reasonably good golfer. That will have some importance at a later point.

**MR. HYBL:**. Good morning. I want to say on behalf of the Board of Directors of the Broadmoor Hotel how pleased we are to have everyone here, especially our speaker this morning, Secretary Aldridge. Pete Aldridge received his Bachelor of Science degree in 1960 in Aeronautical Engineering and his Masters of Science in Aeronautical Engineering in 1962 from the Georgia Institute of Technology.

In 1967, he joined the staff of the Assistant Secretary of Defense for Systems Analysis.

He then served as Director of the Strategic Division at the Department of Defense until 1972, subsequently assigned as Deputy Assistant Secretary of Defense for Strategic Programs until March 1st, 1976.

In 1977, Secretary Aldridge entered the private sector, as vice-president for national policy and strategic systems for the Systems Planning Group in Arlington, Virginia.

In 1981, he was appointed by President Reagan as the Undersecretary of the Air Force, and prior to the Challenger accident, was an astronaut in training.

In June of 1986, he was appointed Secretary of the Air Force. He does a good deal of skiing in Colorado, and it's always great to have Secretary Aldridge here. Please join me in welcoming the Secretary of the United States Air Force, Pete Aldridge.

*EDWARD C. "PETE" ALDRIDGE, JR. received a B.S. degree in Aeronautical Engineering from Texas A&M and a Master of Science degree in Aeronautical Engineering from the Georgia Institute of Technology. Prior to joining the Department of Defense in 1967, Mr. Aldridge held staff and management positions with the Douglas Aircraft Co., Missile and Space Division. In 1967, he joined the staff of the Assistant Secretary of defense for systems analysis and then served as Director of the Strategic Arms Defense Division. He also was advisor to the Strategic Arms Limitation Talks in Helsinki and Vienna. He re-entered private industry in*

*1972 with LTV Aerospace Corp. in Dallas for a year until named Senior Management Associate in the Office of Management and Budget, Washington, D.C. In 1974, Mr. Aldridge became Deputy Assistant Secretary of Defense for Strategic Programs. He was then selected to the Director of Planning and evaluation to the Secretary of Defense. He was named Vice-President, National Policy and Strategic Systems Group for the Systems Planning Corp. In 1981, he became Under Secretary of the Air Force with additional responsibility for providing overall direction of Air Force space programs. He assumed his present duties as Secretary of the Air Force, in June 1986.*

**SEC. ALDRIDGE:** Thank you, Bill and members of the United States Space Foundation, ladies and gentlemen, and as I look around the room, many, many very good old friends.

I would like to thank you for your kind invitation to participate in this Fourth National Space Symposium. This event brings together the top industry, government and academic leaders in civil, military, commercial and international space activities. In these few brief days, those experts will address the key challenges and policy issues facing our efforts in space. As I look around this room, I'm always surprised at the people who attend these symposia. It reminds me of a story I heard recently. The day after General Secretary Gorbachev returned to Moscow following the Summit with President Reagan, he had overslept and was late for a meeting with the Central Committee.

As he was traveling through the streets of Moscow, he ordered his driver to speed up. Well, after the driver didn't increase his speed, Gorbachev again told the driver to get going. Finally, when the driver still did not move faster, Gorbachev ordered the driver to pull over and get in the rear seat. The secretary himself would drive. Two Moscow policemen soon pulled over the speeding car. One of the cops said to the other, "Why don't you go over there and find out which fat bureaucrat is in the back of that limo." The other cop went over to the limo, quickly saluted, returned to the police car. The limo sped away. The cop in the car asked, "Who was in the back seat?"

His shaken partner said, "I don't know, but Gorbachev was his driver."

**We have not lost national security space leadership, and more importantly, we know what we're about and we know what must be done.**

This morning, I feel a little like that cop, except I know who you are, and I know that you are important to our space program. Today I would like to briefly share my perspectives on some of the challenges and the key policy issues facing the Symposium. The continuing public debate over our National Space Program, reflected most recently in the media, has raised many questions about America's space leadership. Many reports proclaim the myth that we are "lost in space."

Well, on behalf of many of us in this room, let me emphatically state the reality. We have not lost national security space leadership, and more importantly, we know what we're about and we know what must be done. We are meeting our requirements and our needs. The high quality of our systems provided us with vital capabilities during our launch hiatus. However, the debate on leadership has been a healthy one. It has made us examine our programs, our concepts and requirements. It has proven to us once again that we do not need to duplicate Soviet programs, but rather, we need to determine our own requirements and to establish the programs to meet them.

The new National Space Policy, announced by the President, provides civil, commercial and national security sectors with the broad guidance they need to establish long-term programs to ensure that America's space needs are met well into the next century.

In relation to the national security sector, our national security space goals are linked to the basic tenet of our national security strategy: deterrence. When we wrote the new space policy, we did so with that fact foremost in our minds.

For the national security sector, the national space policy outlines a distinct long-range path and objective. DOD will develop, operate, and maintain an assured mission capability through a mix of robust satellite control, assured access to space, on-orbit sparing, proliferation, reconstitution or other means.

Simply stated, assured mission capability means we must be able to conduct operations in space at all times, in any environment, peace or war.

**The United States must possess the ability to build and operate quality satellites, launch those satellites when needed, and have the resiliency in our programs to sustain space operations, even if we experience failures in either the launch or on-orbit assets.**

There has been much written and said over the last few years about the concept of an assured launch. In fact, I have personally said a lot about it myself. Assured launch is certainly a critical aspect of our national security space program, and one that almost slipped from our grasp with the shuttle and expendable launch vehicle failures. We were at a critical juncture in our launch capabilities, and that aspect of our program required extraordinary emphasis. Assured launch, however, is not a mission unto itself and it does not stand alone.

It is only part of our overall national security space strategy.

We're well on our way to fixing the launch problem, and it will be fixed this year, if Congressional support is sustained for the programs that we have started. We must now return our attention to the total program.

The United States must possess the ability to build and operate quality satellites, launch those satellites when needed, and have the resiliency in our programs to sustain space operations, even if we experience failures in either the launch or on-orbit assets. This is assured mission operations.

One part of the national security space policy debate has centered on how we should attain assured mission operations. This debate in large part has been over the concept of CHEAPSAT.

This concept is also referred to as LIGHTSAT, SPINSAT, or SWARM, and I've even called it FRUGALSAT on occasion.

Whatever the terminology, we are essentially referring to a simple, single purpose, limited capability, limited life, and inexpensive satellite.

Such systems would not have the degree of reliability or availability normally associated with current U.S. satellites.

These CHEAPSAT concepts represent a point solution to a complex set of problems.

The concept needs to be examined, and evaluated in terms of competing solutions. The cost of the CHEAPSAT solution cannot be measured or discussed in terms of per-unit cost but rather total system and life-cycle cost.

**We can build a CHEAPSAT, but I'm not sure that we have any cheap requirements.**

This implies comparing different mission needs with alternative solutions to include highly capable and effective space system architectures which we pursue today. A primary concern with CHEAPSAT is associated with requirements. We can build a CHEAPSAT, but I'm not sure that we have any cheap requirements.

For example, when I asked our commanders in the field what they need space assets to do, they want coverage and capability over 100 percent of the battlefield, and they want it 100 percent of the time.

This means a day/night, all-weather, real-time, jam-resistance survivable system. These capabilities are not cheap.

Further, the cost of building a CHEAPSAT system may be the proverbial tip of the iceberg. If the United States were to invest in a CHEAPSAT design for a specific scenario or crisis, the real cost of the system is not in the satellite or necessarily in the launch.

The real cost is in the purchase of enough systems for reliable operations, replacement, large on-orbit constellations, and a mobile ground network for control and processing information required to accomplish even the simplest mission.

Finally, the operations and maintenance costs associated with these operations must be examined, as they most likely will be higher than they are today.

We must insure that the United States does not experience a significant increase in cost, and a decrease in capability to proceed down the CHEAPSAT path. Yes, requirements may be specified for a less reliable or less capable simple system, but it is imperative that we retain the capability to meet our total national security needs.

Joe Piotrowski, the Commander in chief of the United States Space Command has said the Soviets have built an operational advantage in launch capacity and resiliency out of a technological weakness, based upon their inability to build highly capable, reliable systems. Let's not take our technological advantage into an untested change in philosophy and turn it into an operational weakness.

If a less expensive way to perform the space mission is what CHEAPSAT advocates are looking for, let me explain an alternative concept that may meet the same objective.

Specifically, the cheapest satellite of all is one that exceeds its minimum design life. A satellite designed with quality and redundancy, embodying our nation's technological prowess, almost always lives beyond its design life, and it's essentially a residual satellite. This extension of capability is essentially free. We buy satellites based upon expected on-orbit lifetime. If they last beyond that, there is no additional production cost.

It is retained on-orbit, in operation, or reassigned to other missions to meet other requirements.

I guess it's what I would describe as the ultimate CHEAPSAT. It's FREESAT. A good example of this FREESAT concept is our Defense Meteorological Satellite Program. Vehicle F-6 was designed for 42 months on-orbit life. And F-7 was designed for a 32 months on-orbit life. Each satellite performed its primary mission for over 14 months longer than expected.

While the main sensor has failed, numerous sub-payloads are functioning and could be used, if required, for mission support. In fact, the 14 months they lasted beyond their expected mission is free. No launch costs, no procurement costs, and no additional costs of operations.

**To endanger the very capabilities we have preserved, which have preserved the peace, could be the costliest decision of all.**

The proven record of performance is what FREESAT philosophy gives to the United States.

It's that performance, that capacity and capability of our FREESAT space assets that allowed us to maintain assured operations, even during the launch hiatus. For it is in the capabilities of our space assets, that the foundation of America's deterrent posture rests. To endanger the very capabilities we have preserved, which have preserved the peace, could be the costliest decision of all. When we consider major changes in policy direction such as CHEAPSAT, I think it is important for everyone to keep a balanced perspective.

Certainly, that's what the President sought with his national policy.

It reminds me of two cowboys who heard that the U.S. Cavalry was offering ten dollars for each wolf that could be brought in. Well, the two, Tex and Slim, signed on and headed into open territory. The first night out they camped in the desert. When Slim heard some noises outside the tent, he pulled back the flap and peered outside.

There by the light of the full moon, he saw a thousand hungry wolves surrounding the tent, all of them ready to pounce.

He reached back in the tent, and shook his partner, yelling "Tex, wake up, we're rich."

**All of us in the space community look forward to the day when the space launch is so commonplace that it does not qualify for the evening news.**

Unlike Slim, I think, all of us in the space community guard against the unjustified optimism, as we develop new policy directions.

With the combined efforts of the Department of Defense, the Congress and the contractors, we have recovered and are flying again with many of our boosters. The new families of Titan and Delta expendable launch vehicles, when joined with the space shuttle and MLV-II booster, will provide us with capability to maintain assured access. All of us in the space community look forward to the day when the space launch is so commonplace that it does not qualify for the evening news.

Our satellite constellation will shortly be totally replenished, with quality, long-life systems that will be supplemented by FREESATS, and I believe a few FREESATS will be there for years and years from now, some operating several times beyond their expected lifetimes, and improving the survivability of our overall space network.

Our National Security Space Program is not the only facet of America's space effort that has recovered. An excellent example of how we were implementing the new space policy guidance is found in our support to the commercial sector.

It is also an area that illustrates how various space sectors interrelate.

In my opinion, the development of our commercial space sector is critical for the long-term viability of the U.S. Space Program and economy.

**Our new National Space Policy, for the first time, formally recognizes the existence of a commercial space sector in the United States, and how dependent we are on a robust space industry.**

Three years ago, the United States space launch industry was dying, but today it is flourishing.

The Department of Defense, and specifically the Air Force, played a key role in the speedy recovery. Our new National Space Policy, for the first time, formally recognizes the existence of a commercial space sector in the United States, and how dependent we are on a robust space industry.

Now, more than ever, we must guard against letting the benefits of our investments slip away to others.

The Air Force has always been in the forefront of encouraging America's space industry. To ease the high cost to industry, we developed a model agreement for making government launch pads, facilities, personnel, and services available to companies on a direct cost, non-interference basis.

The cornerstone of this agreement is flexibility. Model agreements can be tailored as required for each commercial company, big or small. We can also provide additional support through sharing technical information, and insuring whenever practical, that military systems have commercial adaptability.

Our new medium Launch Vehicle Program is another example of this interrelationship between space sectors. By emphasizing procurement of space launches, rather than hardware, MLV-II is a streamlined commercially oriented program.

**We must maintain the fine balance of encouraging, but not subsidizing, this industry.**

Paperwork and government oversight will be significantly reduced in exchange for flight performance guarantees.

As a result, the MLV-II program will afford the industry the opportunity to provide commercial space boosters and launch services.

Encouraging commercialization is an unusual and new role for the Department of Defense, and it presents unique challenges.

We must maintain the fine balance of encouraging, but not subsidizing, this industry. For commercialization to work, we must take a long-term view. We must not only encourage today's launch industry, but we must also encourage research for the future, and incentives for educating tomorrow's space leaders.

Our commitment must be to assure our national goal of access to space for payloads of all kinds, scientific, commercial and military, and at the same time, keep our launch industry off the international critical list.

This brings me to our ALS program efforts. The Advanced Launch Systems, or ALS, is another example of the mutual dependence and balance created by the National Space Policy.

We're well on the way toward initial research and development of ALS concepts. We hope that ALS will not only lift large payloads, but will substantially reduce costs and enhance launch capacity, flexibility and reliability.

**The new National Space Policy, and actions being undertaken in civil, military, and commercial arenas, will ensure U.S. space leadership well into the next century.**

This joint civil/military project will allow us to develop technologies for near-term applications, to current systems, and potentially allow us to build a fleet of transition systems that will lead us to our long-term family of launch systems.

In summary, the new National Space Policy, and actions being undertaken in civil, military, and commercial arenas, will ensure U.S. space leadership well into the next century. America is not lost in space, but we are in a position of looking over our shoulder.

Our national interests extend around the world. The challenges to those interests, and to the interests and security of our friends and allies, also span the entire spectrum of conflict.

Our country's space assets support our ability to respond to those challenges, not to play a game of "keeping up with or beating the Soviets."

Sound space leadership helps us to maintain our current superiority capability and credibility that form the basis of our deterrent posture.

We've gone through an assessment of both NASA, and the role of the U.S. Space Program and national security. With the coordinated vision outlined in our new National Space Policy, we will continue to meet our national interests in space.

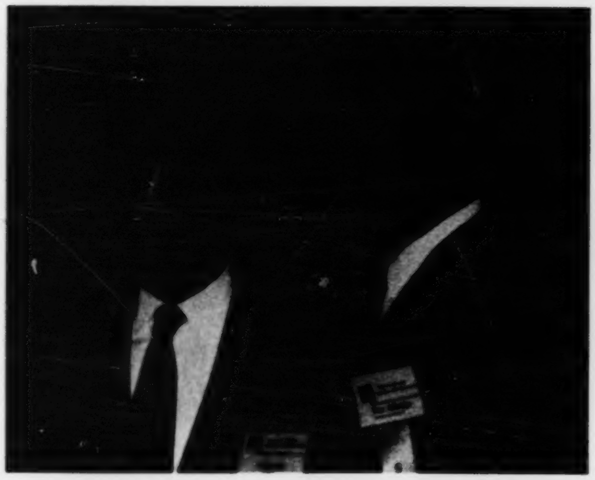
We know what needs to be done. We simply need the national resolve and long-term Congressional support to do it.

Thank you very much; I'm proud to be here with you this morning

**MR. HYBL:** Thank you, Mr. Secretary. The first question is: do you believe that the commercial launch sector in the U.S. will ultimately need their own launch facilities?

**SEC. ALDRIDGE:** That will depend upon how robust the launch industry becomes. Right now, I don't foresee the need to have any dedicated launch facilities, unless there are obviously boosters that will come into play in the commercial field, that cannot use the existing pads.

The way I see it now we have the Titan pads. We will build an additional Titan pad at Vandenberg, and we will modify the launch complex landing pad at Kennedy, Cape Canaveral, for launching Titan III's or Titan IV's, plus the Delta pads, and the Atlas Centaur pads that we currently have. I don't foresee right now any need for additional launch capacity and launch pads unless there are new boosters that come along, which could not use those existing.



**MR. HYBL:** Mr. Secretary, it appears that the Soviets are establishing an excess launch capability. What do you think that they use this for?

**SEC. ALDRIDGE:** It's bothersome. The excess is clearly there. Their launch program and their effective overall space program is dominated by the military, and it is obvious with that excess capacity, the capability exists to significantly expand their military program. It's very bothersome in looking at that capacity as to what they could do with the capabilities that they have.

I would hope that they would not put all that capacity to use and begin building those military capabilities that would threaten our own space assets, but it's very difficult to determine which way the Soviets are going today, other than they are clearly in the space race, the space game, and their technology is not up to ours yet, but it's certainly growing. It's bothersome, but I'm not sure if I could pinpoint any specific programs today that would really frighten us in the future. It's something you just have to continue to look at.

**MR HYBYL:** What is the Air Force position as far as an ASAT to counter the Soviet capability?

**SEC. ALDRIDGE:** That's a very good question. We had a concept of ASAT. Unfortunately, Congress decided we didn't need one for some strange reason. It's somewhat questionable about their logic, and there are a few Congressmen who felt very strongly about that. We need an ASAT, without a doubt. The Soviets have one. They're capable of launching the ASAT to attack our satellites in low earth orbit that are critical to the security of this country, and we have no capacity to do likewise. Our ASAT was designed to target their satellites that are used to target our forces, and for the Congress to believe that we do not need the capability to improve the effectiveness of our military forces seems very, very strange. We need an ASAT, and we're now going back with the decision by Congress to prohibit the testing of the miniature homing vehicle to go look at other concepts of ASAT. There are studies underway to do that now, but at this point, no decision has been made.

**MR. HYBL:** General Abrahamson has recently discussed the use of a large number of small, inexpensive launch vehicles for SDI deployment instead of the ALS. What are your thoughts on this?

**SEC. ALDRIDGE:** I had not heard that statement.

I think he's talking about small launch vehicles for individual experiments. He clearly is; all he has ever talked to me about was ALS and the need for that or some other heavy capacity launch vehicles, such as a variance of the Titan program.

I have not heard anything about him using smaller vehicles for that purpose, and I would think if he was, he would be using things like a Delta for experiments that he's already been undertaking.

**MR. HYBL:** Mr. Secretary, back to the ASAT question. Although we may be ahead of the Soviets in national security and space capabilities, isn't that lead likely to be negated in a time of crisis, with the Soviet use of their ASAT system?

**SEC. ALDRIDGE:** That's one of the primary worries we have: our inability to have our own. Obviously, the country needs an ASAT capability. The effect of the Soviet ASAT is very devastating upon our capabilities because we don't have a large number of satellites in low earth orbit as the Soviets do. Ours tend to last longer, but we have fewer of them, and so even though an ineffective ASAT has been accredited to the Soviet Union, they don't have to launch very many. It is a problem, it has to be solved, and we're looking at all kinds of ways to do that. We have to look at survivability of our satellites, but let me just carry that one point further. It's not just the survivability of the satellite. It also must include the survivability of the ground station.

Only one country can take out a satellite; any country can take out a ground station, so we have to look at survivability across the board for our military capabilities including low altitude, as well as high altitude, satellites.

**MR. HYBL:** Mr. Secretary, where do you place the space program goals as a priority in the overall budget, vis-a-vis other DOD requirements?

**SEC. ALDRIDGE:** It's very difficult to try to say that space is more or less important than strategic or conventional forces. They're all important. I would put space, however, very high on the list, because of the force, the effectiveness that space systems give to the effectiveness of our forces.

Space systems are essentially force multipliers in the sense of looking at programs like GPS, the navigation satellites. These are now within our capabilities, as soon as we get a substantial constellation up capable of accurately navigating, and delivering weapons to the target area, much more accurately than we would have otherwise, getting back to a refueling point with a tanker that also has a GPS receiver, and then getting back to the base. Those kinds of systems are extremely important in enhancing the effectiveness of our forces. I think the military commanders are beginning to realize how much space does contribute to the operations of their forces, and as a result, space will always have a very high priority within our budgets.

Space is important, as well as all the other aspects of our forces. We just cannot afford to underfund the space program, because of the contribution it makes to our capabilities.

**MR. HYBL:** What are the plans for a space-based radar, and are we going to develop this space-based radar in the near term?

**SEC. ALDRIDGE:** As you know, I have ridden the white horse on space-based radar now for about five or six years. I think the country needs to have a space-based radar some day. Unfortunately, the budget pressures that we're going through now are making it extremely difficult to get any new starts for a space-based radar in the program.

I feel, however, that we need to continue the technology work for a space-based radar too, so that when we get to the point where we feel that the imperative of the space-based radar is necessary, then we have the capability to proceed with its development.

I think the country needs one. We ought to have one, it's a matter of when we can afford it, and it is when, not if.

**MR. HYBL:** Your cautious view of the requirements for single purpose satellites, SPINSATS does not seem to be shared by our sister services. Would you comment?

**SEC. ALDRIDGE:** That's difficult to determine. I haven't seen any requirements from our sister services that would dictate otherwise.

Every time I have ever talked to a military commander, when it comes time to determine what the requirements for a system to support his needs are, you find, as I mentioned in the talk, the need for highly reliable redundant, antijam survivable day-night, all weather, real time, all those things that dictate a multipurpose satellite, and it's certainly not a cheap system that we're talking about.

So, I would question that when you really got down to look at satisfying the requirements of the military commanders, when you design the system necessary to do that, it will not be a CHEAPSAT concept. It will be more along the lines of what we're doing today.

**MR. HYBL:** What are the future prospects of SLC-6 at Vandenberg, and could it be modified to accept the Titan IV or some other system?

**SEC. ALDRIDGE:** Yes, it could be modified at a very substantial cost. We, in the Air Force, debated that issue of whether or not to modify SLC-6 or to continue putting an additional launch pad for the Titan IV at Vandenberg. The launch capacity, and launch rate of the Titan missile, dictates that we need at least 4 pads, two on the East Coast, and two on the West Coast, to support future demands.

One option was to modify SLC-6 to carry the Titan IV, at a very substantial cost of hundreds of millions of dollars; however, that would preclude the use of the SLC-6 for future shuttles, and I felt that the country, having spent three billion dollars to build a facility there, ought to maintain the option to fly the shuttle from Vandenberg for polar orbits sometime in the future.

If we spent the money to modify the SLC-6, to have the Titan IV, and then sometime in the future, the shuttle was reinstated for Vandenberg, we would have to remodify that, and then we've lost the Titan IV pad. The cost of going through that cycle would be far more expensive than maintaining SLC-6 for future shuttle operations, and building a separate Titan IV pad. That's our plan at this point in time.

**MR. HYBL:** Mr. Secretary, are our high orbit satellites safe from Soviet attack?

**SEC. ALDRIDGE:** We think so today. It doesn't preclude them being vulnerable for the future. Most of the threat analyses that people look at, project for the future some type of anti-satellite capability for high earth orbits, and we must continue to worry about the survivability of those satellites, and try to develop programs that will give us that capability.

**MR. HYBL:** Secretary Aldridge, I understand the Air Force has been formally studying various roles for the military man in space.

At this time, what, if any, such roles do you see for military personnel in the shuttle, Space Station or elsewhere in space?

**SEC. ALDRIDGE:** The role of the military in the shuttle is very important, because we will be launching military satellites from the shuttle, and many of the astronauts are from military backgrounds. But in terms of the operational role of the military man in space, we're still searching.

We have a military man in space program in which we have developed a series of sequential experiments for shuttle operations that will improve our understanding and knowledge of the role of the military man in space.

We know there's a role in terms of research and development. We have not found the role yet for the operational aspects. There is no imperative, that we've discovered so far, that says we must have the military man in space for military operations.

But we have not foreclosed the exploration, because we think that there may be one out there. We just haven't found it, and these experiments will help us gain the knowledge, maybe, to find that direction in the future.

**MR. HYBL:** Mr. Secretary, a last question. Isn't it true that the Soviets have not tested an ASAT since June of 1982, and prior to that time, less than half of their tests have worked, so it could be considered that they have never had an operational system?

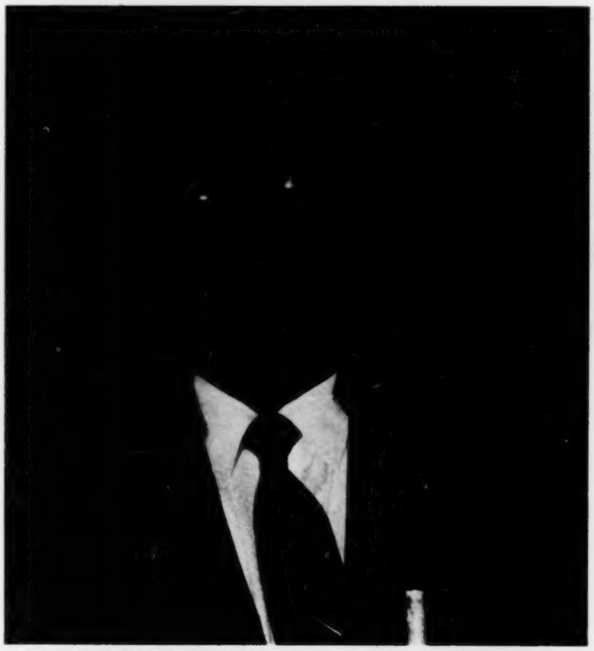
**SEC. ALDRIDGE:** They believe they have an operational system. While the tests that were determined as being failures were for a different type of sensor for their ASAT, they still have an ASAT system. It's operational, and it doesn't have to be that effective to give us a lot of concerns.

The number of satellites we have in low earth orbit are few. They are very, very capable, but the Soviet ASAT system doesn't have to be launched in very high numbers before it begins to bother us.

Our entire military capability is not in just the low earth orbit; we have military capabilities in various kinds of orbits, but it is bothersome that the Soviets have such a capability. They believe that it is an effective system, and they don't have to launch very many of them before it causes us some great concerns.

**MR. HYBL**: On behalf of the Space Foundation, Mr. Secretary, we want to thank you for being here, certainly thank you for your comments. You can tell by the number of people who got up early - they're glad you're here. Thank you very much.

# MILITARY SERVICES REPORT ON SPACE



*GENERAL JAMES V. HARTINGER, USAF, (Ret.) was the first Commander of the U.S. Air Force Space Command (SPACECOM) and Commander-in-chief of the North American Aerospace Defense Command (NORAD), with consolidated headquarters at Peterson Air Force Base, Colorado. Following WWII he earned a Bachelor of Science degree from the U.S. Military Academy at West Point and a Master's degree in Business Administration from The George Washington University in 1963. General Hartinger is a career long fighter pilot, serving in Germany, South Korea and Vietnam. General Hartinger was the F-111 test director at Nellis AFB, Nevada, and then took command of the famed "Flying Tigers," the 23rd Tactical Fighter Wing. General Hartinger was Commander of the Tactical Air Command's 9th Air Force and 12th Air Force. He was assigned as Commander-in-Chief of the North American Aerospace Defense Command in 1980 and became the first Commander of Space Command in 1982. The General is a command pilot with more than 5,000 flying hours and is the first recipient of the Master Space Badge.*

*Moderator:* **General James V. Hartinger,** USAF (Ret.), USAF Space Command

*Speakers:*

*U.S. Space Command:*
**General Wayne Knudson,** USA,
Director of Plans, U.S. Space Command

*Naval Space Command:*
Rear Admiral (Sel) **David Frost,** USN,
Commander, Naval Space Command

*Air Force Space Command:*
**Lt. General Donald J. Kutyna,** USAF, Commander,
Air Force Space Command

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**MR. MACLEOD:** The next panel is intended to provide us a military space update. This is intended to tell you factually where we are in each of the Services, and as we go on through the day, you will see again the Q&A will draw out the judgments after the presentations have been made.

The moderator for the next panel, General James V. Hartinger, was the First Commander of the U.S. Air Force Space Command, and Commander in Chief of the North American Aerospace Defense Command, with consolidated headquarters at Peterson Air Force base.

Following World War II, when he enlisted in the Army, he received a Bachelor's degree in Science from the U.S. Military Academy at West Point, and a Master's degree in Business Administration from George Washington University.

General Hartinger is a career long fighter pilot, serving in Germany, South Korea and Vietnam. He was the F-111 Test Director at Nellis Air Force Base in Nevada, and then took command of the famed Flying Tigers, the 23rd Tactical Fighter Wing.

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General James V. Hartinger.

**GEN. HARTINGER:** I didn't realize what an impact it was on a guy to become a high roller in the civilian world until last weekend when I was playing golf with Dick MacLeod out at Kissing Camels Golf Course, and the 7th hole was a Par 3 over a pond. I was on the frog hair on the back side of the green, and Dick chilly dipped his tee shot in the pond. I was sitting in the cart, and he looked over and said, "Would you throw me a ball please," and I threw him a new Titleist and he teed it up and hit it in the pond. He said, "Would you throw me another ball, please." I threw him one. He teed it up and hit it in the pond.

After he hit five of my new Titleists in the pond, I said, "Dick, why don't you do something different, you're running me out of golf balls."

And very indignantly, he looked at me sitting in the cart and said, "General, if you can't afford this game, you'd better give it up."

There's been a coincidence in the space world. Six years ago this week, General Tom Marsh, Commander

Systems Command, and I took a decision briefing to the air staff on activating a space command here in Colorado Springs.

**Six years ago this week, General Tom Marsh, Commander Systems Command, and I took a decision briefing to the air staff on activating a space command here in Colorado Springs.**

This briefing had stemmed from our Corona, our Four Star meeting in February 1982, two months prior, down at Homestead. That's when Tom and I first proposed activating a Space Command, and we and our staffs had worked on it for weeks to get ready to brief all the other Four Stars; and we used the same reasons that you heard the Secretary use today. We must have assured access to space; we must have assured launch capability. We don't want to militarize space; we want to protect our interests in space. We reminded them that we were getting very dependent on space systems and communication, intelligence, navigation, surveillance, warning, weather forecasting; and with this increased dependence went increased resource commitment, which dictated that we provide the most effective management possible. We thought we could do that with an Operational Space Command.

The acceptance of the idea was kind of a mixed bag, but we had five or six executive sessions, and at the end of the last session, General Lew Allen, Chief of Staff of the Air Force said, "Okay, Jimmy and Tom, bring a briefing to the air staff," which we did, and the proposal was approved. The announcement was made a few weeks later, and on 1 September 1982, we had an Air Force Space Command here, and Pete Aldridge came out to run the ceremony.

**A lot has happened since then. We have a Unified Space Command, an Air Force Space Command, a Naval Space Command, an Army Space Command, a Space Technology Center at Albuquerque, three space wings here, the Consolidated Space Operation Center out at Falcon, and the National Test Facility out there.**

A lot has happened since then. We have a Unified Space Command, an Air Force Space Command, a Naval Space Command, an Army Space Command, a Space Technology Center at Albuquerque, three space wings here, the Consolidated Space Operation Center out at Falcon, and the National Test Facility out there.

We've come a long way, but how far have we come? Where are we? What have we done? We're going to find out today. We're going to get a status report from the three service Space Commands. Our first speaker representing the Army Space Command, is General Wayne Knudson who's the Director of Plans here in the Unified Space Command. Wayne came to the Army as an enlisted man in 1960. He received his commission as second lieutenant in the infantry in 1962 at Fort Benning. He is a Ranger, an Airborne and a chopper pilot. He's had two tours in Vietnam, two tours in the Pentagon, and I've got to tell you about his medals. He has a Distin-

*MAJOR GENERAL WAYNE KNUDSON is director of Plans for the United States Space Command with headquarters at Peterson Air Force Base, Colorado. He earned a bachelor of science degree in Industrial Management from the University of Alabama, Montgomery, in 1969. The general is also a graduate from the U.S. Army Ingantry School Advanced Course, at Fort Benning, Ga., in 1969; the U.S. Army Command and General Staff College, Fort Leavenworth, Kan., in 1972; and the U.S. Army War College, Carlisle Barracks, Pa., in 1978. General Knudson's military decorations and awards include the Distinguished Service Medal, Silver Star with one oak leaf cluster; Distinguished Flying Cross with four oak leaf clusters; Bronze Star Medal with three oak leaf clusters; Meritorious Service Medal with one oak leaf cluster; 60 Air Medals including one with "V" device; Joint Service Commendation Medal and the Army Commendation Medal with one oak leaf cluster. He has earned the Combat Infantry Badge, Parachutist Badge, Master Mary Aviator Badge and the Ranger Tab. He assumed the rank of major general on July 9, 1987.*

guished Service Medal, two Silver Stars, four Distinguished Flying Crosses and 61 air medals. I told him that if I had gotten 61 air medals, I would have had to collect a few of them at the bar. But let's give a hand to our green suiter, General Wayne Knudson.

**GEN. KNUDSON:** One thing I won't talk about is SPINSAT, LIGHTSAT and CHEAPSAT, for obvious reasons; but there are those of us who are working the idea pretty well. It isn't obvious in an environment which is a little dark and shady that I might be Army, so I want to make darn sure nobody misunderstands that, and I want to make a little modification of uniform today. I am not in the Air Force, and I am obviously not in the Navy. I would like to work today, though a poor substitute for Lt. General Wall, who is Commander of the Strategic Defense Command and was to come here and present to this forum today, but due to pressures in the Washington area asked me to pinch-hit for him and I'll do so. I don't have his slides, so I had to use my own, but what I will do is to work a little bit on the role of where we're coming from in the Army in space these days.

We had a milestone last Thursday: the Chief of Staff, General Buono came out, and activated the United States Army Space Command, Peterson Air Force Base, Colorado. We've been working on that for a couple of years; we had an activity there we've been calling the Army Space Agency.

Up on that chart, on the right side for you, is evidence that the United States Army, over time, reaching back to the beginning of the space activities, was involved. The initial activities, booster activities, were accomplished and supported by the Army, and we've continued over the years to have some role. At the establishment, though, of the NASA program, quite a bit of the activity the Army had been doing was moved over to NASA, to include most of the people that the Army was paying for at the time to accomplish that function.

What is going on more recently, then, on the left is the wiring diagram of where and how the Army is somehow involved in space.

Very complicated, probably, a little decentralized from your point of view, relative to other space environments today. I think you will see, though, the Army tighten up the focus on who all is involved in this space business and find one or two or three more principal notes. Significant today, though, is the Army Space Command here in Colorado, and from the BMD point of view, the Strategic Defense Command which operates its headquarters in Washington and Crystal City, and operates its primary research arm down at Huntsville, Alabama.

On the right-hand side are the activities that are aligned with the Army Space Command as of its activation. We have involvement in space surveillance with radars that are out of Kwajalein Atoll. We have agreed and have put people out at the CSOC to assist in the crew operations of the Global Positioning System; all of the NASA astronauts that the Army provides are assigned to the Army Space Command.

In this environment, then, is where the Army goes from. The Army goes from the ideas of air-land battle operations. We're not going to change that. We are an air-land battle operations land force system. So, the role principally of the Army Space Command is to share in the burdens and responsibilities of the United States CINCSPACE, but also to assist in providing space support to all the Corps-type operations, wherever they may occur around the world, and the Army forces are assuredly around the world.

As you look at what it is they think they're messing with then, these kinds of diagrams are for battlefield synchronization and seeing what it is we want to do. Some of that, if not most of that, is best done from the highest ground you can find, and assuredly space is high ground.

**So the cavalry of these next decades may be space forces, where you can best communicate, best navigate, best see, and therefore support better the platoons, and the divisions of the Corps of the United States Army.**

And thinking through that, the kind of operations that this hat represents, Cavalry Operations, tend then to be the kinds of things that an Army will want done with the cavalry. So the cavalry of these next decades may be space forces, where you can best communicate, best navigate, best see, and therefore support better the platoons, and the divisions of the Corps of the United States Army.

In looking at in what we define as the space domain, we tend to describe it mostly in two operational areas. An analogous sea control is where we come from on space control; and if you understand what it is about sea control we would do, we would do the same thing in accomplishing space control. We have to watch it; we have to participate in it; we have to assure our access to it, and if so authorized, we would want to deny a hostile enemy the use of that same environment.

Other than space control is space support, supporting activities of communications, navigation, and anything else. Those are the two basic common denominators from which we want to define support in the space environment.

In terms of what it is we're doing in space control, we look principally at these functions: we have to surveil space, and we have to protect the assets there.

Over on the right, in space surveillance, we're pretty good as a nation, at least at this time. We have lots of phenomenology, phase array radars, bistatic radars, electro-optical, so we surveil space quite well, and we use a lot of not just military resources, we also use civil and commercial resources to assist in space surveillance. Many of the resources are dual use. Those phased array radars up there are also a part of ballistic missile warning system, but because they're phased arrays and electronically steerable, we point them to space, and they also do space surveillance.

In terms of what we have in the way of military satellite systems today, the chart on the left shows the kinds of systems that have been assigned to the CINCSPACE by the JCS, and most of these systems come from and are operated by the United States Air Force, not exclusively, but most of them are. Over on the right, I have put a chart up on the kinds of communications systems that we look at. The military satellite communication system is aligned with the United States Space Command, and each of the Services, including the Army and the Navy, have a part of that military satellite communications system, and they involve today mostly in the SHF category, the DSCS system put up by the Air Force, operated by the Army. The EHF system which is coming up is MILSTAR, which will be operated by the Air Force; the UHF system is operated by the Navy fleet SATCOM, and some day, we may have more capabilities listed up there, such as the laser communications or SLCSAT-type of communication systems.

All the Services, then, are partners in providing military satellite communication systems.

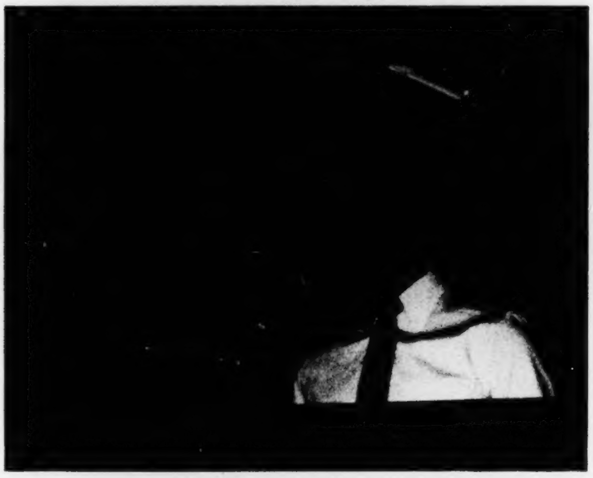
In the case of the Army's DSCS for those of you who know it, it is a synchronous system around the world (SHF). On the right are the sites in which we do support the military forces with SHF communication systems. The Army operates all but one of the ground sites at the present time, and that ground site will also be transferred in the future from the Air Force to the Army, so in that case, we'll have that structure operated through the JCS, by the Army Space Command in Colorado Springs.

Also coming to that decision was another idea: the idea of regional space support centers. Around the world there will be established initially three regional space support centers that are sited in such a way that they will associate with the various U and S commands to assist their understanding and planning for and planning of the use of space systems.

The first capability is coming with the Army's DSCS Operations Center, so the first capabilities will be in assisting and how to utilize to the best advantage their allocated capabilities in SHF DSCS systems. But over time, expanding that support to also advising them on how to best employ what's there today in GPS or any of the other satellite systems, and also not always to be an Army- only group, it will become a joint group of people operating principally under the J-3 of the United States Space Command.

Things that are going on that the Army is obviously excited about: Navigation. We've been working map and compass, and guys like me have been running around in the woods forever trying to figure out where's the moss on this tree, and moss doesn't grow in the southern latitude on the north side of the tree. The Global Positioning System provides us various capabilities so that we can always assuredly know exactly where we are, down to meters, and to do it on land, at sea, and in the air is something that all the armed forces look remarkably to. We're also looking to it in this nation, outside the military sectors, civil and commercial sectors. It would be a neat trick if we could put GPS receivers in the vans that run around cities like Chicago trying to deliver goods to individual doors and houses, that they could have a receiver on that thing, so that they knew where they were in Chicago, and where the target was so they could get there more gracefully. And those applications will come on also, I think, essentially, concurrently with the military roles of the systems.

At this point in time, I'm going to convert and cheat a little bit. I'm not going to continue to be just the Army. I'm going to play a little bit of unified, and in conjunction with that, I have to get this Army uniform changed just a little bit. Excuse me. I need to get my space hat on.



It's a unified space hat, joint space hat, represents all the Services. I also need to get my joint uniform sorted out here a little bit. This nice Navy/Air Force shirt, or Navy shirt, excuse me, and these Air Force epaulets, and by the way, I also have a Marine Corps belt on here, so I've got them all covered. I also have civilian underwear, however, so I represent you too.

The United States Space Command does now have then three legitimate components, all the commands of differing sizes; the Army is the smallest; the Navy is in the middle, and the Air Force is the largest. Over time, I would expect that they would always be that kind of way, and we all have a different focus on things. The Army is going to focus on the corps; the Navy will focus on the battle groups, and the Air Force will focus on the MCDAC and SAT forces of the Air Force, but we will all take a slightly different focus on the process.

The mission of the United States Space Command, as in all commands, comes out of the environment of the unified command plan. Basically, we support missile warning for NORAD; we support the space surveillance, and also the activities of the Strategic Defense Initiative by planning for the requirements and concepts of operations.

The compelling things that are on the right are what it is we must do. We're here to support the war fighting CINCS, so all the eight U&S commanders of the world rely on their support to come from the CINC Space and his components.

As we look at what it is that's exciting to us, GPS is coming on-line. We'll get the real constellation going this fall, and over a short period of a couple, three years, get that system up and operational.

Also coming down the line is the MILSTAR, the EHF communications system, which will provide us improved communication system for tactical and strategic operations. It also is designed and will be coming down reasonably soon.

Another area of work, however, is the work with the Strategic Defense Initiative in planning for the requirements and the businesses of ballistic missile defense. There are also a series of things that have been going on all the way from General Abrahamson's office, building assistant's COMSAT papers, the JCS working on a document to say what's the minimum initial requirement, and going through a major decision process this summer to initiate what has been called Demonstration Validation of Phase 1, Strategic Defense. What are we worrying about? We're worrying about the set of ballistic missiles, both the ICBM and the SLBMs, as we worry about those, what it is we would like to pursue as national goals for how we should contend with this situation, and whether or not there's an alternative over time — over time meaning many, many years — to whether or not the Mutual Assured Destruction sort of theory is the only way to contend with the system, or can we back down and find another strategy in the ideas of defense, and bring in two nation states into a different strategic equation.

As you look at what took place this summer, on this chart, it was a decision that we will obviously have to deploy in phases, and the top line is the initial capabilities that are mostly matured today and will proceed to initiate with this phase of work.

On the right, are the system elements that were concluded to go into demonstration validation by the Defense Acquisition Board, now taking another privilege of color coding those as to what service, probably, if not absolutely, will be the owner/operator and the developer of them. So the space segments listed on the right side and above of BSTS space-based interceptor, and space surveillance and tracking system are going to be developed and owner-operated probably by the Air Force. Back on the left side, you see the ERIS, or the Exoatmospheric Reentry Vehicle, you see a ground-based radar, and you see a ground based reconnaissance system or sort of a probe.

You also see up there three kinds of command control. There's a shield going across the top, it will have to have a joint command control system, and in our judgment, each of the two components will have to have a supporting command control system for it. Also in the bottom left is a program that Mr. Aldridge mentioned, the Advanced Launch System. It would seem to bring this whole architecture to bear over time, we will need an improved launch capability, so it also should proceed into demonstration/validation level of time framework.

Documentation, what are we up to? We're documenting the entire requirement. I finished the document really about Christmas time, called "The Broad Concept of Operations," in which we said, if the whole banana were here, here's about how I think I would like to see it. Here's what its characteristic should be, here are the interfaces. Resuming those with the decision on demonstration validation, we started to proceed in the specific concepts of operation for the Phase 1 system, those system elements we looked at earlier. And we've also begun to document the service military requirement documents, SONs, ROCs, SORDs, to document the specific characteristics of each system element of that Phase 1 Strategic Defense System.

In terms of what we also worry a little bit about, I've modified this left-hand chart for you, you saw it earlier, to stick on the bottom some tactical ballistic missile concerns. The Strategic Defense Initiative is also concerning itself with the Tactical Ballistic Missile Defenses, and that series are those of concern in the tactical ballistic missile area, or theater missile area, as the Army would frequently call it.

Are there any left? Yes, the INF treaty and others remain, and those others are significant in quantity, and they also could be pushed technologically. So there still remains a theater missile issue on which we have to work.

Working on it principally is the Strategic Defense Command, General Wall's command, whom I am representing today, and I have highlighted that part of his mission assigned to him by the SDIO and the DOD, to work on this theater missile problem. So as he looks at what he's doing, the bubble charts on the right show how his organizations are expected to work on the series of problem areas all the way from CONUS Strategic Ballistic Missiles Defense to some kind of theater defenses, and across the bottom, employ all the various technologies that we might find in the SDIO, and in any place else to help work on the resolution of those kinds of problems.

In terms of what and how we do this, I'm going to make a play for what we really need is the business of modeling. So the idea of the National Test Facility out here at Falcon and for the National Test Bed which hooks up Los Alamos, Sandia and a number of other places to have an interacting distributed analysis system that will be a six degree systems engineering simulation of our system is the only way we're going to do this thing. We're really going to build the simulation. We're going to test the empirical parts of those simulations to make sure that the long poles in it will work, and the system is probably going to be best represented by simulation. So that kind of a class of activity is compelling if we're going to do this thing smart.

Some other areas of assorted interest. The idea is, in Strategic Defense, to balance. What do I do with my defenses to facilitate my offenses over time; how do I use my defenses in lieu of offenses, and over time, finding the equation for the balance of how much offense and how much defense, and how do we interact these two to make them work properly.

And on the right-hand side then is the partnerships, it is not a single-focus, single-thread program, it's a program which must be interacted with a number of other areas of concern; particularly, for instance, I'm also interested in not just ballistic missiles in space, but up there, air defense, and the association with the Air Defense Initiative.

Though we're interested in how the ADI part comes into the equation, so we have total CONUS and/or North America's strategic defense. To facilitate that, General Piotrowski established an organization in house, called the Joint Integrated Strategic Defense Planning Staff, to make sure that myself and the planner for NORAD, and the people working in SDI and ADI bring some bridges together, and we do an integration of how it is we defend the nation and/or North America against nuclear issues, both the cruise missile issues and ballistic missile.

Other interested areas; yes, I would think that the government and the space command are still interested in the ideas of a man in space. Mr. Aldridge referred to those. We also look at how we can and should employ civil and commercial assets in the DOD domain, and the Command has been asked to facilitate planning for the use of civil and commercial assets in support of our national security goals. A partnership is necessary, not just a partnership among our military partners, but with these other national entities, with the Academia, with allies. So the process of building military space operations is a very large process that requires collaboration, participation by all. And we have lots of subjects we want to work on, space-based radar, for example. We do want things like that, and we would like to find the means and the capabilities to pursue that.

In closing, the Command has a lot of areas of interests. You'll receive a discussion a little later by Adm. Breast, talking about the Command in more detail, but we are here to please. I leave you with a recruiting slogan: We need for all of you to look at your sons and daughters, and nephews and nieces, and say come and help our nation in defense.

Thank you very much for your time.

**GEN. HARTINGER:** Next we hear from the Commander of the Naval Space Command, Rear Admiral Selectee, David Frost. David is a graduate of our Naval Academy in '63; and in '67, he graduated from flight school. He had two tours in the Pentagon, and two tours in Vietnam. He was commander of three fighter squadrons, one of them being the Top Gun Squadron. He gave me a note saying that he wanted me to introduce him as the world's greatest fighter pilot, but I told him in this Air Force environment, there's no way that a Navy guy could qualify for that.

In the Pentagon, he was the F-14 Program Director. He was Commander of the U.S.S. Seattle, that's a floating supply depot, and I understand from my Navy friends that the fast burners, the high rollers are given that as kind of a test bed. If they can run that, then they're okay. Well, David must be okay, because after commanding that floating depot, he was selected to be Commander of the U.S.S. Saratoga aircraft carrier. I have been on aircraft carriers, and I can tell you that's the toughest job in the Navy.

David left the Saratoga to become Commander of the Naval Space Command in Virginia last month. Let's give David a hand.

*REAR ADMIRAL (SEL) DAVID FROST is the Commander, Naval Space Command, at Dahlgren, Virginia. He graduated from the U.S. Naval Academy with a Bachelor of Naval Science Degree and was commissioned in the Navy as an Ensign in June 1963. During his aviation career, Rear Admiral Frost has accumulated more that 3,200 flight hours and 800 carrier landings. His awards include four Meritorious Service Medals, 14 Air Medals, four Navy Commendation Medals with Combat "V", and the Vietnamese Cross of Gallantry.*

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**ADM. FROST:** I have been in this job for less than a month as he said, so I'm delighted to be here. Being a career-long fighter pilot, I am used to competitive environments. After listening to Gen. Knudson's speech, I see I underrated the competitive environment here.

As most of you know, the Naval Services has a long history in space. It goes back to the 1800s, when the Naval Observatory was founded. And most of you know better than I do the role it's played in the technological

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advancement, particularly, in precise measurements of earth motion, and precise measurements of time.

Naval Research Lab (NRL) and Applied Physics Laboratory (APL). NRL, put up the first TRANSIT system, the Navy's first navigational system, the first operational constellation in space, and of course, you all know that many Navy and Marine Corps fliers have participated in the man in space program.

This slide just talks about some of those contributions to the space effort, the early contributions to the space effort. What I want to point out is the NASA spinoff up there. The NRL provided about three hundred of their best engineers to form the part of the initial nucleus of NASA. And as I said, APL rather, put in our first navigational satellite constellation.

So we've been in space for a long time, but there was a growing feeling along toward the end of the '70s that some of our efforts in space, as they grew in complexity, and as the number of ideas grew, and the ways operational support for the fleet could be grown, that our ideas and our management of the Naval Space Plan was not as focused as it could be, hence the Naval Space Command, which was stood up in about 1983, in October.

> **We're taking our sensors from the masthead to space, and giving ourselves the ability to look farther over the horizon.**

Admiral Watkins, who was the CVO at the time, said at the establishment of the Naval Space Command, that we really, in space, are doing nothing different from what we do at sea, we're just raising the horizons in the same way that General Knudson just mentioned. We're taking our sensors from the masthead to space, and giving ourselves the ability to look farther over the horizon.

I might take a minute here to point out to you, though, that as you noticed from the biography that was given about me in the introduction, I have no background in space, per se, at least not the way most of you think of it. By the standards of almost anybody in this room, I am a complete space rookie. What I do bring, however, is a strong operational background. I have had about 15 years at sea, and the Naval Space Command's mission, is to provide the bridge between the hard operational requirements of the war fighters at sea, who are deployed around the world at all times, and the many ideas, programs and technologies that are becoming available in space. And if you understand why the Navy would send a man with more of an operational background than a technical background in space to a job like this, you will understand the Navy's approach to space.

We do several different things. The first thing we do is we operate satellites. We, of course, have, as the General mentioned, the Navy FLTSAT communication system, we have the Transit Navigational System; we have several others that you are probably pretty well aware of.

The second thing we do, however, is we provide tactical inputs into the fleet. Our entire focus is on tactical applications of space. That means really two things, and we focus on these two things.

First, it means the tactics to exploit our own systems as well as we can, and to provide the best possible support for the fleet operators that are deployed around the world. Secondly, that means understanding as well as we can the Soviet threat, the capabilities, limitations of their space systems, how they are directed against our fleets, and how to exploit their weaknesses.

The third thing we do is that in our plans department, of course, we watch the various programs going on around the space world, and try to make a coherent input for the Navy on what it is best to make our investment in. We have many more good ideas running around than we can afford, of course, and we have, even within the Navy which is a bureaucracy like any other large organization, a lot of different voices in space. It is our mission to bring these voices together into some coherent plan.

Now, to do this, the Naval Space Command is under the CNO, although that does not really reflect my real chain of command going up. I have several bosses; one, of course, is the Chief of Naval Operations; the other is the unified command out here, General Piotrowski, the Space CINC here. I also have some direct liaison with our fleet CINCs, over tactical applications of these programs. I have three subordinate commands. One of them is the Naval Astronautics group out of Point Mugu which flies our TRANSIT satellite system. Another is the fleet surveillance support center. This is not really a space program, it is the over-the-horizon radar, very large antennas, although it's not a space program, it was given to me because the kind of connectivity and the kind of information that it develops, over the horizon information, is similar to that provided by Space Systems. The way we have to get that information out to the fleet is similar to the way we have to distribute space information, and so I inherited this thing.

And our third one is SPASUR — our space surveillance fence.

We at the Naval Space Command see — and I have heard this same theme mentioned many times here in the Symposium — see today as sort of a crossroads for our opportunities and the direction we're about to take in space. We see this for a couple of reasons.

The first reason, I think, is because our fleet operators are becoming much more accustomed to using space resources, U.S. space resources — many of you are familiar with the TENCAP program which was simply an effort to take national assets and give them tactical applications.

We've done that. Over the years, we have become more and more familiar with how to exploit all national systems.

On my last deployment in the Mediterranean — last summer, Saratoga's battle group was in the Mediterranean — I saw this very clearly. We use space resources daily, we can think of more applications all the time for space resources; the fleet operators are becoming more and more comfortable using these things, more and more knowledgeable about the potential applications.

And of course you must also remember the operators have two important things. One is, they see the world a little differently than we do in Washington, or in other headquarters staffs. They deploy around the world, all the time, they are concerned about extending their horizons directly every day. And the second thing about the operators, in the Navy, it's particularly true, the operators have the largest voice in setting our requirements.

**The second reason, I think, that we are at a crossroads, or at a threshold is because we look with more and more concern at the Soviet space activity.**

If the fleet says it's a requirement, it's a much more powerful articulation of that need than if the idea springs up in Washington.

For those of you who care to market space systems to the Navy, I think there's an important point there, and that is aside from the usual rounds of offices in our normal bureaucracy, it's important to stop in and see these fleet commanders, these operational flag officers who are more and more conversant and more and more demanding on the need for space resources.

The second reason, I think, that we are at a crossroads, or at a threshold is because we look with more and more concern at the Soviet space activity.

We see a very robust capability. We see them launching frequently. Of course in the Navy, as we sail the world's oceans, we are a natural target for their surveillance systems. We spend a lot of time, as I already told you, talking about and developing ways to exploit the weaknesses in their systems, to make ourselves less vulnerable to their targeting, to their surveillance. By the way, I might add on that point, we are getting a more sophisticated approach toward this. There were a lot of operational commanders in the Navy, and I'm sure this is true in other services, who took the attitude for a long time that space was a nice thing in peace time, but they assumed automatically that the space resources would go away, because they knew the Soviets had an ASAT capability, they had heard of Soviet lasers, and they know also the fragile Com links that have to take place between our ground stations to get the information out to the fleet, and, of course, some of our Com satellites themselves are now susceptible to jamming.

So some operational commanders took the attitude that space resources, as a class of things, as a class of hardware that might serve them, was nice in peace time, worthy of exploitation in peace time, but going to go away in war. Well, we're taking a more sophisticated look at that again, and we're beginning to realize there's a lot we can do to prevent that from happening, and we're beginning to realize that there's a lot we need to do in the hardening, and making our future systems much more survivable.

We look at Soviet space activity with some admiration, but with a lot of interest, because a lot of it is conducted directly against Naval assets at sea.

The third reason that we're at a threshold is that you in industry are providing us with just an ever-blossoming family of ideas on how to take our space efforts further.

**We're beginning to realize that there's a lot we need to do in the hardening, and making our future systems much more survivable.**

We are hearing ideas from simple ways to make existing systems slightly better, to some very exotic and expensive ideas on applications that we can see might have value, but must, of course, compete for the budget. I'm talking about things such as space-based radar, which has already been covered. For the Navy, ASAT, taking it to sea. If ASAT is ever going to come off the forbidden list, there are some very attractive reasons why taking an anti-satellite capability to sea, since a lot of the Soviet reconnaissance system is devoted against Navy ships, would be an attractive idea to us; however, if we do that, we have to expand our space resources at sea to have the kind of command and control setup that's going to make that happen, meaning taking space surveillance to sea, taking telemetry, command and control to sea, and so forth.

Even we have had, at the more exotic end of the spectrum, we've had ideas presented to us about taking major space launch capabilities to sea, not just out of ships, not just out of vertical launch tubes in the existing Navy ships, but major, sort of floating space launch ports.

**We have a very difficult challenge ahead of us trying to sort these many good ideas out into what is the best investment for the Navy and for the country.**

Of course, all of these ideas have potential, and while we have lots of factions within the Navy that care to consider these ideas, many of them couldn't come at a worse time from the budget point of view. You are all familiar with not just the Navy's, but the entire Department of Defense budget problems. We have a very difficult challenge ahead of us trying to sort these many good ideas out into what is the best investment for the Navy and for the country. Our budgets are limited. I do think, however, that because of the first point that I made- because of the growing awareness on the part of the fleet commanders of the things that they can get from space, I think that in spite of the budget pressures, the space share of the Navy's budget is going to increase, and even though it's difficult budget times, my job, again as an operator or as a representative of the operators is to help and effectively articulate the demands, sift through the best ones and find which is the best investment or investments for the Navy.

**I think that in spite of the budget pressures, the space share of the Navy's budget is going to increase.**

I think that's all I'm going to need to say. We at the Naval Space Command are very highly charged right now. We're excited about the future. We see a growing role for space in the Navy, we see a growing investment in space by the Navy, and we expect to be at the center of the decision process within the Navy for how to spend that money. Thank you very much.

**GEN. HARTINGER:** Our clean-up hitter is Don Kutyna, Commander of the Air Force Space Command. Don graduated from West Point so he can't be all bad.

He also went to MIT and the Industrial College of the Armed Forces. He was a fighter pilot, a 105 driver in Southeast Asia. In 1965, he went to Edwards and he was in the business of training test pilots and astronauts. He had two tours in the Pentagon, and one in Vietnam, and I can tell you that flying 105s over there was tough.

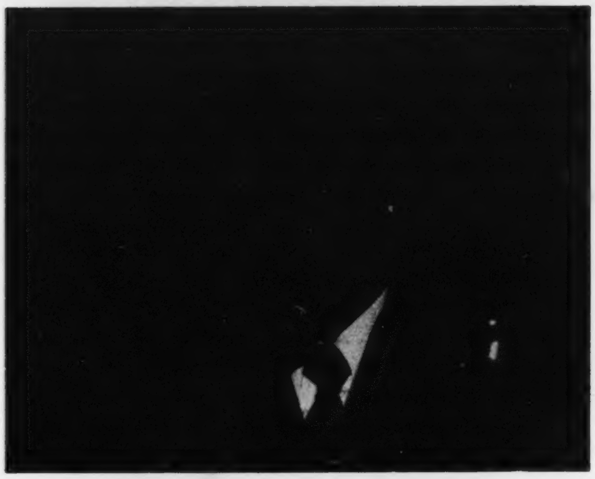
He served with the Electronics Systems Division in Boston and he served in the Space Division in several capacities.

He was Deputy Commander for the Space Launch and Control Systems. He managed the DOD shuttle program. He was responsible for the construction of Vandenberg, and in 1986, he was Vice- commander of Space Division, prior to coming here and becoming Commander of the Space Command.

In 1987, he was the recipient of the General Thomas D. White Space Trophy that's annually given to the person that contributes the most to the nation's progress in space.

Don Kutyna.

**LT. GEN. KUTYNA:** Thank you, General Hartinger. It's really a pleasure to be introduced by my old boss, and by the First Commander of Air Force Space Command, and also who, by the way, is also the winner of the Thomas D. White award for 1983. A very unusual winner, because he was the first true space operator given that award which is normally presented to those from the research and development community.



*LT. GENERAL DONALD J. KUTYNA, a graduate of U.S. Military Academy at West Point, flew 120 combat missions in Southeast Asia, serving as flight commander and on the Wing Staff. At the Aerospace research Pilot School he trained test pilots and astronauts fro U.S. aircraft and space programs. General Kutyna was program manager for foreign military sales of the E-3A Aircraft Warning and Control System aircraft, and later was assistant director for the overall E-3A program. With the Space Division, Air Force Systems Command, he managed the DOD Space Shuttle Program, to include design and construction of the Shuttle launch and landing site at Vandenberg AFB and other operational aspects of the launching process. His programs for control of space missions included upgrade of the AF satellite control network, development of the Space Command's Consolidated Space Operations Center, and modification of the NASA Space Shuttle Command and Control facilities. General Kutyna hold a B.S. from the U.S. Military Academy, an M.S. in Aeronautics and Astronautics from M.I.T., and is a graduate of the Industrial College of the Armed Forces. He has more than 4000 flying hours in 25 different aircraft.*

I would also like to note that he is the one who is responsible for the design of my new Space Command Headquarters Building out at Peterson Field. I say that, in answer to many of you in the audience who have asked "who in the devil built that place." It's really a great headquarters, boss, and I appreciate being the first tenant.

Some of you here in the past may recall that a couple of years ago, I gave about a 45-minute briefing with sixty slides on space technology.

Last year, I had those same sixty slides, and as the General and I passed each other on the way to the platform, he said, "Kutyna, you've got ten minutes." It wasn't much of a speech, but I got credit for the first supersonic delivery in Broadmoor Center. Wayne Knudson, however, I think you hold the record today.

Well, I learned my lesson, and this is going to be a very short summary of where the Command is in this fifth year. There's some confusion regarding what the Command is. When I go out and tell someone I'm the Commander in Space Command, I often get introduced as General Piotrowski. General Pete is my boss, but he is a Commander of the Unified or U.S. Space Command, and the Air Force is one of the three components of that unified command.

> **I've got three prime missions for the resources that we own: First to give warning of ballistic missile attack; second, to provide near and deep space surveillance, and third to perform satellite control for the majority of the DOD satellites.**

Our job is to organize, to train, to equip and to sustain the force and the resources for Unified and NORAD.

General Pete of the Unified Space Command will employ these forces in times of conflict. General Pete is the warfighter commander, and we provide him the forces.

I've got three prime missions for the resources that we own: First to give warning of ballistic missile attack; second, to provide near and deep space surveillance, and third to perform satellite control for the majority of the DOD satellites. For ballistic missile warnings, we've got sensors all around the country and in space.

I've got some late additions to that network and the latest are an upgrade of the Thule radar, replacing those large football field sized radars we had up there with a new phased array antenna. That was completed in 1987.

In Fylingdales, England we'll do the same thing with a three faced phased array. That will be completed in 1992. And then, submarine for launched missile warning, we've put in new systems in Robins, Georgia in 1986, and in Eldorado, Texas in 1987. They're all up and operational at this time.

For deep space surveillance, we have a large number of sensors, many of which you've heard about already, from the Army, the Navy, and the Air Force. They're radar, they're optical, and they're electro-optical, and they pretty much span the world. The primary mission of these sensors is to give the make-up and the deployment of the space force structure, both theirs and ours; and, to give warning of space-based attack on our assets.

The newest addition to this network would be a radar in Saipan, with an initial operational capability in 1992; and, we're looking at 5 GEODSS, electro-optical sites, to be installed in the eastern Atlantic some time in the next few years.

Our third mission is to operate the satellite control network, which we transitioned from Air Force Systems Command on the first of October of 1987.

We're fully operational with that network now, and it also spans the world.

My newest tracking space station is right here in Colorado Springs, and it will be operational in June of 1988.

There are many upgrades continually going on in this network. CSOC is complete, as you all know. I've got my crews in place, and satellite operations are transitioning at this very moment and will be completed over the next couple of years.

That wraps up my short overview of where we are in space, except I would like to summarize my top priorities.

First and foremost, is cooperation with the Army, and the Navy Space Commands which are now on board to provide the best force structure to General Piotrowski that we can. Specific to the Air Force, a Number 1 priority first and always is to provide adequate and timely space missile warning. Second, to continue to build our ability to satisfy the needs of the users in the satellite control network, and finally, to ensure that there are no shortfalls as we take over the mission control centers for our major satellite systems.

As I sat in the audience looking up at General Knudson and Admiral Frost, I thought about 28 years ago. I was a brand new aircraft commander on an airplane called the B-47, with a crew of three. I was the aircraft commander, I had a navigator from the Naval Academy and a co-pilot from the first class of the Air Academy. Thus, we had a crew of 1957 Army, 1958 Navy, 1959 Air Force Academy. I find myself in that position again today with the three commands, Army, Navy, and Air Force Space Command working hand in hand to make this a much better armed forces for our country.

Thank you very much.

**MR. MAC LEOD:** We'll ask our panel members now to take their seats up at the table for questions and answers.

**GEN. HARTINGER:** Here's the first question. Would anyone like to say something nice about CHEAPSATS?

**GEN. KNUDSON:** The alternatives, sir, are myself or Admiral Frost. I would just, I guess, make about two sentences of remarks. Mr. Aldridge's concerns are not illegitimate. He and I have talked about them considerably, but the theme behind the issue that some people like myself raise, and more people from the Army and the Navy, is that our tactical forces, our corps, and our battle groups of the two recently joined services in space have finally found themselves not only using space support, but it's come to be a key denominator that they cannot any longer do without. So they register concerns as to how will I assuredly have support from space when I need it. And the inclination has been to take a look at various ideas of whether or not we should employ, principally the higher technology class of satellites through national technical means, or is there a practical alternative, by what I would prefer to call single purpose satellites, not single purpose inexpensive satellites. So let's set equations for size, power performance, on-orbit spares, and reconstituable satellites, and determine where the needs in these curves are to get what Mr. Aldridge called assured mission support.

Our statement is that it's not time to decide, and assuredly, we're not taking any run on the idea of the necessary technology satellite, the high technology satellites that are necessary for the national purposes; as a matter of fact, they've got to grow and get better, treaties like the INF and others that may follow, require bigger and better. The issue to you, how do we assure the general purpose support of the three military departments. Let's study it, expect it, contemplate it, and maybe we can form decisions over the next two or three or four years as we look at our options.

**GEN. KUTYNA:** Let me take a shot at it; to follow along what Secretary Aldridge said, we're not all against the CHEAPSATS, but you've got to recognize the requirements of the users out there, and, when you go to the user, he says yes, I want a CHEAPSAT, but I do want it to be responsive, I want it to be survivable, I want it to give me worldwide coverage: yes, it's got to be antijam, it's got to be all weather, it's got to be day/night; and, it's got to be available. I'm building that right now. It's called MILSTAR, with a launch in the early '90s.

**ADM. FROST:** I guess I would only add from the Navy's point of view in particular, we see some requirements for a cheap satellite — some satellite communication uses — which could be launched from ships as we know them, perhaps even out of the vertical launch tubes. The satellite that's going to go up in a launch vehicle small enough to fit on a normal ship is going to be an austere satellite, and may look very much like what's called CHEAPSAT.

**GEN. HARTINGER:** Next question. The past development of joint commands is a fragmented turf battle. Is this still true? Let me take a shot at that first.

People have asked about Tom Marsh and me, and how we two strange bed fellows got together? Well, we were classmates, we were close friends, and we talked about a space command for years. Tom Marsh saw the development of space systems as an exact parallel to the development of the airplane. Eventually, the operational world would be launching space systems and he saw that. He was willing to sacrifice; he was willing to let his commander of Space Division, also be my Vice Commander of the Air Force Space Command.

You have to take your hat off to Tom Marsh, and I knew that all the unified commanders, especially CINC NORAD, needed support of space systems and the best support could be provided by a Space Command. So very easily, I don't think there's going to be a turf battle in the unified arena.

I think this is the way we had to go; to develop and activate a unified space command. We had to do it in case there's ever a time of conflict or crisis in space. General Piotrowski, CINCSPACE, will be the leader in any space combat.

**GEN. KUTYNA:** As the oldest guy up here in space, let me say that it's not going to be a turf battle. There will be some minor arguments between us, but you've got to ask, is space like ships where only one service is building the ships, or is it more like aircraft where all three services have a very important role in building and operating those air-craft? To me, space is very definitely like the aircraft example. All three major services will have a hand in building space vehicles, and some will be unique to that service; others will be Common-user. I don't think any of us can have a monopoly on those systems.

The Navy can build a Common-user and the Army can build a Common-user just as well as the Air Force can; or, for that matter, a specialized satellite. The only important thing is to make sure that each service builds these spacecraft according to their ability to do the research, development, and acquisition on those birds and operate them as best they can.

**GEN. HARTINGER:** Okay. Next question, it is obvious that DOD has opted out of the manned space flight, to-wit: Cancellation of SOPC and continual insistence that "there is no requirement for military man in space," and so forth. What do each of the panel members feel will be history's judgment of the civilian and military leadership that allows such a view to become a policy. How about that?

**GEN. KNUDSON:** With my joint uniform on I still have it on underneath — the idea of a military man in space, has yes, over the years been debated considerably. The role of the military and the business of the astronauts corporation over the years has been significantly competitive, as pilots will probably continue to be dominated by military people, but there is, from other points of view, the idea that militarily manned operations in space may continue to make ultimate sense.

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**The Soviets and their MIR Space Station are conducting what we consider, in all probability, significant activities, as they're supporting their national security interests.**

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Some points of view that I would express and give you maybe the theme is that the Soviets and their MIR Space Station are conducting what we consider, in all probability, significant activities, as they're supporting their national security interests.

We have, in previous roles — and Admiral Frost may wish to comment in particular — had persons in space who looked out on the oceans and the land masses, and given the superior computer of the human brain, and the binocular, instead of monocular value of the human pair of eyes, seen and discerned, militarily significant events from space.

From space, I think is a term that needs to be watched out for. How far up are we talking? A hundred, two hundred, three hundred, four hundred miles? And then in an environment that isn't that far, if you can stand that high and look — if you, this morning, were to stand out at the airport and look south/southwest, you would have seen a pair of mountains 115 miles away, and seen them quite clearly, and had we had handed you a pair of respectable binoculars, you probably could have seen animals running around on those hills.

So it does seem we should continue to be sensitive about the role, all the way from supporting the satellites, in terms of non-orbit repairs, reinstruments, refurbishments, refueling, to what it is there might be in command control-built management and reconnaissance support that the human might provide that machinery won't. But as Mr. Aldridge said, I think, we don't know what we don't know, so we're compelled to get up there and try, and see what it is we can do better.

**ADM. FROST:** I will agree with that. I think we all have a gut feeling that there is potential in this area, but we are so far in the infancy that we have yet to come up with a really exciting idea that's going to cause us to get into this in a bigger way and develop it faster.

**LT. GEN. KUTYNA:** I agree with my two contemporaries up here — we're not necessarily in the infancy. John Glenn wasn't always a senator, or was he one of the first military men in space. We in the Air Force have been looking at military men in space; the SOPC was not military man in space, it was planned to help us fly the shuttle, but the mission model is down to such a degree, that we've decided to let Johnson Space Center do that; but, we've got a whole list of military man in space experiments to fly on the shuttle, as soon as we can get that bird flying again.

The Air Force Scientific Advisory Board looked at military man in space, and while we haven't got a specific mission, there are three things that a man or woman can do in space better than a machine. Number 1 is manual dexterity. You can build a robotics contraption and try to do what man can do manually, you just can't equal it. So if you've got to build something, if you've got to maintain something, you have to consider man in space to do it. Number 2, is the requirement for a brain on orbit. Now, there are certain situations we've got to have that brain on orbit instead of telemetering down to the ground, and in those situations we use man in space. And then finally, while we have many sensors, any one of which can beat any sensors that man has: a sensor can see better in space than I can with an eyeball; it can hear better in space, than I can, and on and on; but, there is no machine up there that can take the inputs of all of those sensors and correlate them the way we do in our brain and come up with a decision to do the right thing. And that's why we need man in space. The missions will come in time, as we have a chance to explore.

**GEN. HARTINGER:** To Commander Frost: Given the Navy's track record on Clipper Bow, ITSS, and NROSS, is the Navy really serious about space?

**ADM. FROST:** My judgment on that is definitely yes, but I can certainly acknowledge where people would have the right to be skeptical, when they look at some programs that seem to make sense that ultimately don't get funded. I guess NROSS, which was a next generation weather satellite, may be a pretty good example. There was a lot of support for it. It looked like a feasible piece of technology, but I think — and I've heard many, many, different assessments on why the thing ultimately was unfunded I think the most common reason I've ever been given, and I guess the one I believe is that we could not convince our fleet operators that this represented a big enough improvement over our existing capability to be operationally significant and, therefore, it fell out in the funding battles.

I think, I repeat, I think that we are serious about space. We are serious about it, because we have some unique service requirements. We're pretty aware that there are places like the Persian Gulf, like the Gulf of Sydra and other places, we have unique requirements that we're going to have to satisfy for ourselves, but you have a right to wait and see how these budget wars come out.

**GEN. HARTINGER:** Okay. There's been concern expressed about Soviet ASATS. Are we giving adequate determined attention to the protection of our ground base space downlinks against earthquakes, riots, helicopter attack, power failures, and other bad things. Dr. Bob Wood.

**We need to take the next step and build something new out there with some of the very simple new systems we already have put on aircraft so we can bring the cost of getting into space down and reliability up.**

**GEN.KNUDSON:** Let me mention again, in the period of time since the formation of Space Command, I think attention is being paid. It is not all done.

The idea that the command has, for this function, alternative activities to the Cheyenne Mountain Complex, therefore, an alternate space surveillance center has been established and operated by the able men at Dahlgren, and the space defense is operated also by Dahlgren. The Air Force has moved around its activities in which the Onizuka Air Station does now belong to the Air Force Space Command, and we aren't quite so relied on the intersection in California of two interstate highways. And Gen. Kutyna operates redundant and primary facilities at CSOC. We have done things like Falcon, in which we rerouted as the second source, the communications lines. Are they done, no. But I think the military attitude, and in looking at our military space support has begun to build the kind of redundant and alternative things that are important to resolving that issue.

They continue to be very high priority activity, in our promise and budget and integrated priority list of activities.

**GEN. HARTINGER:** Is there a national requirement for both the Shuttle-C and the Advanced Launch System? Is Shuttle-C a near term ALS?

**LT. GEN. KUTYNA:** I don't think so. Shuttle-C is 20 year old technology, and that's what's got us grounded right now—that very costly technology. We need to take the next step and build something new out there with some of the very simple new systems we already have put on aircraft so we can bring the cost of getting into space down and reliability up.

**GEN. HARTINGER:** Any other comments? The antiballistic missile defense is basically prohibited by international law. How do you justify this strategy?

**GEN. KNUDSON:** Well, the ABM treaty doesn't restrict the activity. We are doing a research program within the boundaries of the treaty. We are even doing it within what we call the restrictive interpretation of that treaty. The activities to deploy an antiballistic missile defense system would be in opposition to that ABM treaty, but those decisions have not been made, and it is not envisioned they will be made for some years, and well into at least the early, if not the mid '90s. There is overwhelming evidence, and we are expected continuously in the research family to ensure that the research activities live within the restricted interpretation of the ABM treaty. It is challenged, frequently challenged by persons overseas, sponsored by the Soviets, to keep us busy writing paperwork on how it is that the actual radar is ABM compliant. We do a lot of that kind of work, and we have many lawyers making their living doing that.

So I'm confident, personally that we live within, not only within, but within a very restricted interpretation of that treaty at the present environment.

**GEN. HARTINGER:** Okay. Gen. Kutyna. What is Air Force Space Command's plan for becoming the Air Forces launch operator?

**GEN. KUTYNA:** Clandestine.

**GEN. KNUDSON:** Let me take another point of view. The Joint Space Command's Unified Space Command has been a poser of the theme that the Air Force, some years ago, used to launch the DSMP satellite; the Army and the Navy both launched lots of great big rockets and boosters. We do it, in the case of the Army, with E-7s, and second lieutenants at White Sands launching things like Pershings and Patriots. The thought was we then launched so few satellites, so few over the years, that each launch is kind of a research oriented thing. No two boosters go up exactly alike.

Can we get, over time, into the idea of the sheer launch operations, in which we have a type classified, fully standard sort of booster in which you can reduce the reliance on the research and civil supports and add supports to it and scrutinize space launches, and wouldn't we target it to go firstly to the Air Force component?

At the time that the debate was taking place, Gen. Kutyna was down in the Space Division, and now he's up here, but I think it will be, continue to be an item of interest to the unified command, that we should try to scrutinize space launch. The only question is how can we get to that, and reasonably, the Air Force will be the one you would look to first, because they have most of the launchings, and most of the satellites with our Air Force Space Commands.

**GEN. HARTINGER:** Do you feel that we should establish a "space force" to manage all of our future space needs?

I would like to comment on that first. When Tom Marsh and I were trying to sell the Air Force Space Command, we mentioned that the Reorganization Act of 1947 states that combatant commands are required in fighting wars; so by law, we had to eventually activate a Unified Space Command. But an idea was to activate a space force. We were against that, and in fact, it got a little heated one day, and one of my contemporaries said, "Jimmy, you little SOB, you want the whole enchilada."

And I said, No, I don't want the whole enchilada, but we must have a Space Command not a Space Force. So we looked at a Space Force in detail, and we concluded that in was not in the picture.

So far it hasn't been. What do you guys think?

**GEN. KNUDSON:** Well, I'm going to stay with the theme. We've got the three military departments, and we've got three components, and we have a unified headquarters, and if there's an issue, let's just establish a space force uniform for the unified headquarters, and I have it on. Cheap. Won't cost us a damn thing.

But it would seem that it isn't right at this time to look to creating another service, and it's been discussed before. The Defense Department discussed it carefully, the idea of a special forces service, over the last two years, because of an issue in the Congress to strengthen the U.S. special forces activities, and it doesn't seem to me that it makes that much sense at this point in time for the size of the group that we're dealing with, and it doesn't seem to me that it should be made a great idea.

I spent quite a bit of time with other nations, who have joined their military departments into a single service and over time, they've decided that it wasn't the greatest of ideas. So to do that here, with our space family, when it isn't the space family that's supporting it, it's the space family supporting corps of battle groups, and tactical Air Forces, and so, to remain in brotherhood with them, by being a member of their service on temporary duty to a space force sounds like a better equation. So I guess I would vote quite against it.

**LT. GEN. KUTYNA:** Wayne, you've heard many times from General Henry and others who has stood up and said, "Space is a place not a mission," and all three services have got to plan that mission. One of the shortcomings up there, is that we've got tremendous capability and great potential, but the services really don't understand it yet. They haven't used it to the extent that it can be used. One of the ideas of having Army, Navy, and Air Force Space Commands is to get the word on space capabilities out — into the Army, into the Navy, and into the Air Force. Let our commanders see what we can do, and give them the power that space can give them. By making a space force, we'll just pull it away in some separate entity and be out there in the cold by ourselves.

**ADM. FROST:** I agree.

**GEN. HARTINGER:** Okay. The entire panel, the last question: All services operate a family of systems to accomplish their respective missions — augmenting large, costly, complex survivable, capable systems with smaller, cheaper, simple, relatively expendable basic systems. Why doesn't a family of satellites, including a CHEAPSAT, make sense to meet overall requirements?

**GEN. KUTYNA:** We have a big family of satellites. I guess I don't understand the question. If CHEAPSAT proves out, it will be one of that family.

**GEN. KNUDSON:** I think the theme of a family is possibly right. When you look at our national requirements, the requirements get very, very, very rigid. The kind of precision necessary to support some of the national needs are very high precision. The precision for an Army Corps Commander, he doesn't want to count the wheels on the tank, he just wants to know if it's a tank and not a 5,000 gallon tanker.

So the theme of a family, I think, will grow over time, but it's not intended nor should we intend at all that we're trying to compete the tactical satellite support requirements or support to tactical forces requirements with the requirements for national technical means, and both are required, and they must be fulfilled through some means, and if the means is cooperative joint use in the same system, that should be the decision.

**GEN. HARTINGER:** That's it, thank you for coming. There's going to be a press conference in the building next door if anybody wants to come over.

**MR. MACLEOD:** Before we thank the panel here, I need to comment on a comment Gen. Hartinger made earlier. He leaned over to me and said, "In the midst of all of this, you know, an angel appeared to me and told me that I'm unique in world history. That after God made me, he broke the mold, tore up the plans, and there will never be anyone else like me."

And I think any of you who know him can believe that.

But what actually happened at that point was Gen. Kutyna leaned over, because I had an incredulous look on my face, and said, "You know, I heard the same thing; I was there when the angel appeared. What General Hartinger didn't tell you was that God considered that a safety precaution for the human race."

**QUESTION FOR GENERAL KUTYNA**: If you had your druthers, what would you acquire systems-wide to accomplish your #1 priority? What options are available in terms of upgrading current systems?

**GENERAL KUTYNA**: Our number one priority, as you know, is Integrated Tactical Warning and Attack Assessment (ITW&AA). Currently, we are pursuing ITW&AA system upgrades in the Mountain as our number one systems acquisition priority. Several programs are now underway to upgrade this capability. These include: Communications System Segment Replacement (CSSR), Command Center Processing and Display System Replacement (CCPDS-R), Space Defense Operations Center (SPADOC-4), Granite Sentry, Survivable Communications Integration System (SCIS), and Attack Warning Processing and Display System (AWPDS). Other new systems include the Offutt Processing and Correlation Center (OPCC) at Offutt AFB, NE, and our Mobile Command and Control System (MCCS). These programs will improve our survivable communications; air, missile, and space warning processing capabilities; forward user integrated data displays; and the survivability of our integrated data processing capability. Together, they offer a significant upgrade to our ability to correlate multi-mission data and provide it in a survivable, timely, and efficient manner to national decision-makers and military commanders worldwide.

**QUESTION FOR GENERAL KUTYNA**: With the cancellation of NPB ISE, why has Air Force relinquished its role in the Neutral Particle Beam development to the Army?

**GENERAL KUTYNA**: Neutral Particle Beam (NPB) experiments have historically been Army projects. One of the first was Project White Horse in the 1970s. In addition, DARPA had programs in the 1980-1984 timeframe with the Army as their agent. There was a natural evolution of these developments to SDIO with the Army responsible for ground-based technology demonstrations. With the advent of the SDI-initiated Integrated Space Experiment (ISE), the Air Force became involved because it was space-based and because of our responsibilities for space operations and expertise in space systems development. The ISE was a very aggressive project with high risks, but very high pay-off. As a minimum, it looked very good for discrimination of targets. However, as budget reductions have occurred, the SDIO found itself in a position where it could no longer afford the NPB ISE programs, If the technology evolves such that project costs are within the SDIO budget and the risks are significantly reduced, these decisions could be revisited, and the Air Force would play again in this important area. The Air Force is fully committed to supporting SDI objectives and applying its manpower/resources to meet these objectives. Although the Air Force will continue to participate in some of the NPB technology developments, there will be no major program office established at this time.

# U.S. SPACE OPERATIONS

*Moderator:* **Dick MacLeod,** Executive Director, U.S. Space Foundation
*Speaker:*
**Rear Admiral Jerry C. Breast,** USN,
Director of Operations, U.S. Space Command

**MR. MACLEOD:** Rear Admiral Jerry Breast is Director of Operations for the U.S. Space Command. Adm. Breast was born in Tennessee and received his degree from Vanderbilt. For 20 years, he was a single-seat attack pilot, (that is a fighter pilot, both attack and fighter). He drove ships for the next ten years, and commanded the USS Savannah and later the aircraft carrier Independence.

Most recently, he commanded the Corral Sea battle group in the Gulf of Sidra, before resuming his current position.

He's got 335 combat hours, and he's now in the hot seat of operations in this unified command.

We're pleased to introduce today Admiral Jerry C. Breast.

*Rear Admiral JERRY CREIGHTON BREAST,USN, is Director of Operations, U.S. Space Command, and Deputy Manager for the Space Transportation System Contingency Support Office, with headquarters at Peterson Air Force Base. Rear Admiral Breast graduated from Vanderbilt University in 1958 with a NROTC commision and a degree in physics. After receiving his wings in 1959, he spent the next 17 years in the Navy flying single-seat, light attack aircraft (A-4s and A-7s) from attack aircraft carriers. On shore duty, he attended the U.S. Naval Postgraduate School, U.S. Naval Test Pilot School, the Naval War College, Catholic University, and served in test flight tours at VX-5 and Naval Air Test Center Patuxent River, Maryland. These tours led towards a Master's Degree in international politics, subspecialty in aeronautical engineering, and designation as a Weapons Systems Acquisition Manager. Rear Admiral Breast assumed his present duties in January 1987 and was promoted to Rear Admiral (upper half) on March 1, 1987.*

**ADM. BREAST:** Thank you very much, ladies and gentlemen of the U.S. Space Foundation. This is my first experience here, I'm something of a stand-in, but I've learned my lessons well, and my first lesson came back when I first got to Colorado Springs and met Gen. Hill. I had not met Gen. Hill before that time.

I had heard, prior to meeting him, that he was a very impressive skier and sportsman and fisherman, and so, immediately after meeting him, I mentioned the fishing prowess, and Gen. Hill invited me to go fishing with him. I was most appreciative of that, because I was new in town, my family wasn't here yet, and so forth. So we went down to the Pueblo Reservoir, and as we came out of the back of the station wagon, with this little flat bottom boat, one paddle, a tackle box, and a scoop net, I kind of wondered about Colorado anglers, and where all the great traditions of fly casting and so forth was, and I didn't say anything. I kind of questioned the non-existence of the fishing poles.

I got in the back of the boat, he got in the front, he kind of wiggled his hand, and we paddled out about a hundred yards off shore, He opened up his tackle box, and pulled out a stick of dynamite and lit it and threw it in the water, 50 yards away, and it went off, and fish started floating to the top of the water. He kind of wiggled his hand in that direction, and I paddled over there, and he took the scoop net and scooped them out.

I said, "General, I just cannot believe this. This is not at all what I had in mind. I'm really a little bit ashamed to be fishing this way, even though it is the most productive afternoon I've had."

And I went ahead to protest for another two or three minutes. He opened up his tackle box again, lit a stick of dynamite, handed it to me, and said, "Did you come to fish or to talk?"

So I learned about retired Air Force officers, and their fishing prowess and aggressiveness, and I want you to know, ladies and gentlemen, that today I came to fish and not to talk, and so that's where we'll be going with this speech.

In effect, it's a hell of a predicament to be somewhat untenable in these respects. In the first place, I'm a Navy dive bomber pilot, turned ship driver with 14 months really, 14 full months of space experience, including a C-minus in U.S. Air Force acronyms.

We're two days into this Symposium, which reads like an Olympic gathering of "Space Greats," maybe that's appropriate, the Broadmoor has always been an Olympic training ground.

I'm following the Secretary of the Air Force, three component commanders, and the mad Viking Wayne Knudson. Probably most spectacular of all, I'm speaking at the unclassified level, when the only other thing that

I've learned about space in fourteen months is that if it ain't an acronym, it's compartmented, so we're in trouble. To top it all off, I'm a substitute for Bill Ramsey, who is far and away, the Navy's most learned, most experienced space operator, and I stand in awe of his knowledge.

He should be here in place of me, and I appreciate the Foundation asking me to cover his tracks. So I want you to know, I'm really happy about the task that you have given me today. I'm really excited.

I want to talk a little bit about space operations, U.S. Space Operations, Military Space Operations, what it boils down to is bombs on target. What it boils down to is being able to put your fighter into the six o'clock position of the enemy's fighter. What it boils down to is being able to properly target, however sophisticated your weapons may be.

Now, there are other ways of getting there but in the final analysis when deterrence fails, those are the types of things that space operations mean.

Perhaps in peace time, it means being able to maintain the peace through the most vigilant security processes we can. And a warning, maybe it means deterrence by the most robust capability and potential, robust potential as well as capability, but when deterrence fails, the bottom line of U.S. Space Military Operations comes to the battlefield commander, being able to aid, assist, supplement his armed weapons progress.

If we don't think that way, then we might as well turn the whole organization over to NASA and back out of it, because we don't have any military applications in space, and that is certainly not the way in which the United States is going or should go.

While I'm in the area of phases of space operations, let me mention to you a concept which has occurred to me after playing four separate war games as U.S. CINC Space and being soundly defeated in each of them. That concept is the uniqueness of the threshold of space warfare. All of you know the three vertical levels of conventional, and then, perhaps, chemical, and then, God forbid, nuclear warfare. What I am describing is the potential for a much lower threshold of warfare, an initiation of hostilities, for instance, wherein no blood is shed, no satellites even need be destroyed, but, perhaps, slowly even insidiously, some of our most important constellations are degraded until they are no longer effective constellations. The source, perhaps, even the fact of that existence and happening may be completely transparent to the owner-operator, or to the war fighter.

**The realization of this intriguing threshold of warfare is apparent to me and to us right now, not because we have the capability to employ it, but because it exists as a threat to our space-based assets.**

The realization of this intriguing threshold of warfare is apparent to me and to us right now, not because we have the capability to employ it, but because it exists as a threat to our space-based assets.

Frankly, we are without space weapons.

As the operations officer of the U.S. Space Command, there are no bullets in my belt. We have no weapons.

I'm reminded of the movie, "High Noon," Gary Cooper stalking down the empty street, and he may do that again today, as our space hero, but he darn well better be able and agile and be able to duck and weave, and bob and dive into the gutters because he sure can't shoot back.

Regrettably, we have nothing to deter potential enemies from attriting our space assets, and as good as they are in peace time, I am skeptical that we build them to sustain war time punishment.

**As the operations officer of the U.S. Space Command, there are no bullets in my belt. We have no weapons.**

To continue the analogy of the "High Noon" gun fighter, matters are made worse, since there are very few deputies in reserve who can be rushed to the scene of the battle or confrontation.

This is not the way the west was won, and I'm not sure it's the way the west is going to be kept. Old Coop would likely have stayed at the bar, even if Grace Kelly had been the prize.

Okay. So, I have told you, as a dozen, probably, coming before me have mentioned, one or two of our confrontational weaknesses. Now, let me be confrontational in another way. I have never seen so damn many conventions, space symposiums or similar forums in all my days. In the past 12 months, there must have been 40 major conferences of the military and industry to try to unlock the secrets of U.S. Space inertia, and although I don't doubt for an instant, the good faith, the earnest desire, the patriotism, and even willingness to risk an occasional corporate buck, I am not sure there is a congressional ground swell of support for space renovation. To the contrary, it rather reminds me of an attempt at a Denver Bronco wave in the fading seconds of last

**Are we so bound up with terrestrial structure and command and control, that we have neglected to mount the space ships on their steeds, and send them into the arena, or at least keep them in the stables in reserve?**

January's Super Bowl; the ground swell is not there.

Of course, I should not be picking a fight if I don't have a set of answers to stand on. In a sense, biting the hand which is attempting to feed me is a rabid reaction, and I lay claim to it, but I have to believe that we need to marshal our votes and our clout on the steps of Congress; that we need to tell the American people that we have fielded a team, which is robust in peace — and it is that, the technology is there. It's impressive, the life of the satellites is five times as long as we designed them to be — it's robust in peace and toothless in conflict; that we need to examine the structure and infrastructure that we are building.

The centers and the COM activity, the works, and the networks, the myriads of networks, the computers, and the endless repetitions of software that they drive. Are we so bound up with terrestrial structure and command and control, that we have neglected to mount the space ships on their steeds, and send them into the arena, or at least keep them in the stables in reserve?

Have we priced ourselves out of competition? Have we made astronauts unexpendable? Naval aviators are expendable. I may be in the process of expending one right now. Army helicopter pilots are expendable. Marine embassy guards are expendable. Any time we build a gold-plated space program, like a gold-plated tank, it will not be an effective fighting tool or weapon. We can't afford that as a nation, fiscally or operationally.

**Any time we build a gold-plated space program, like a gold-plated tank, it will not be an effective fighting tool or weapon. We can't afford that as a nation, fiscally or operationally.**

Lest you think that this hypocritical bastard standing on the podium is up here taking shots at you, let me assure you that the military is equally prepared to share some of the guilt. We assume a defensive crouch any time inter-service controversies arise. Rice bowl protection flourishes as does a reluctance to sponsor any program that's not invented here. The worst travesty is the hoarding by services of special access programs in the name of security. Unfortunately, progress is impeded by these institutional traditions, and if we want to develop a fighting team, we must eradicate this type of friction. In the final analysis, it is the soldier in the field, the sailor on the bridge, the airman on some dusty Middle East air field, who needs space. U.S. Space Command exists to support the fighting men of every theater CINC. General Piotrowski has said that in every theater, in every forum that he's had a chance to say it in; to coordinate every space asset, our components, and, perhaps even our allies.

**General Pete...has created a space campaign plan, which can tell our national leaders where our deficiencies lie.**

These are needed to provide connectivity, intelligence, positioning, and control to the war fighter. General Pete has started us on that path. He has created a space campaign plan, which can tell our national leaders where our deficiencies lie. He has asked the best minds in the nation to help us work these problems. He went to the White House at the invitation of the liaison office, six months ago, to brief 40 senators and one showed up. He has asked the best minds in the nation to help us work these problems by creating a Space Scientific Advisory Board, which has just finished having its first formal meeting at Building 1470 at Peterson Air Force Base this past week.

**The smart money will probably stay in the saloon at the bar with Coop, and not go out on the streets, but not a single one of you ladies and gentlemen out there got where you are by ducking this kind of battle.**

But he needs your help, in the research, and in the direction and education of the nation's law makers. Funding for one of the five years in the fiscal year '90, FYDP, is no longer existent. That's what a 20 percent cut means. It means we're going to stand down the military for one of those five years in the FYDP. It may get worse than a 20 percent budget reduction over the FYDP.

So in summary, the smart money will probably stay in the saloon at the bar with Coop, and not go out on the streets, but not a single one of you ladies and gentlemen out there got where you are by ducking this kind of battle. It's time to fabricate some weapons; time to hire some deputies that can be responsive.

Thank you very much.

**MR. MACLEOD:** The first question is what role does the Navy foresee for the National Aerospace Plane in future Naval operations and responsibilities.

**ADM. BREAST:** I can't answer that question.

**MR. MACLEOD:** Admiral Breast, would you consider it an attack on our systems to degrade the capabilities prior to conventional hostilities being initiated an act of war and, therefore, a deterrent to others' attack?

**ADMIRAL BREAST:** Would you consider an attack of our systems, I think, that means on our systems, to degrade capabilities prior to conventional hostilities being initiated, an act of war, and, therefore, a deterrent to their attack.

Now maybe that means an attack on our systems to degrade their capabilities prior to conventional hostilities being initiated an act of war, and therefore, a deterrent to their attack.

Well, that's a very scenario dependent situation. It certainly is a possibility. It would depend upon, I think, how effective any attack that we might make on their satellite capabilities might be. In other words, how broad, how effective it might be, and how large a portion of their war fighting capability we were able to take out.

Now, not only is it scenario dependent, but it's also very hypothetical, because when I tell you we don't have any weapons, I'm speaking truth. We folks from Tennessee, seem to drawl a little bit, but let me tell you, as best I can determine, what I told you with respect to our inability to attrite is a factual statement.

**MR. MACLEOD:** If and when a treaty is signed to verifiably ban weapons from outer space, what kinds of things can our military do cooperatively with the Soviet military?

**ADM. BREAST:** I think that's an interesting question, and I'm sure there's a whole broad spectrum of things we can do. One of the first things that I would say we ought to do is to jump quickly into the areas in which they are further ahead than we are, and one way that they're further ahead than we are is in the military manned use of space. Anybody who thinks that those cosmonauts that are out there going around and around, aren't conducting some military experiments and learning a lot about that dual eye-balled human computer with an articulated device, that they're not learning a lot with respect to manned applications in space, is wrong. So that would be one of the first ways I would start: find out what they know that we don't know. And then maybe there are some things that we can share with them, that would enhance the potential for peace in the future. After all, war is when deterrence and strategies break down and peace fails, so the first objective, of course, is the maintenance of peace, and in that respect, I think you built your satellites and your space structure very, very well.

**MR. MACLEOD:** Looking ahead to Friday's session on MEDIASAT — when news gathering from space with the photo reconnaissance satellite is owned by the media: presuppose such a system exists and is operating and can reveal Soviet capabilities or activities, would you consider a Soviet attack on a commercial U.S. MEDIASAT an act of war?

**ADM. BREAST:** I would certainly consider it to be somewhere between a terrorist act and an act of the commencement of hostilities.

I would also say that once again, we are very scenario dependent. If we have had a scenario that has built us up to a point where we feel very intimidated by the threat of hostilities, and all of a sudden, there's an overt move against one of our satellites, then. I would think that that would contribute to the decision necessity that has to come out of our NCA on a very short order.

The problem is, there is no immediate tangible in-kind quid pro quo, and that's what I've tried to say to you today, that there's nothing that we can hand back to them, that is, in fact, an eye for eye, and, as I say, in playing previous war games, we have seen this type of thing occur, not only to space-based assets, but to terrestrial-based assets as well.

**MR. MACLEOD:** There have been several reported incidents of U.S.S.R. laser illumination of our satellites. How serious a threat is this considered to be?

**ADM. BREAST:** I think in the future, it's considered to be a significantly serious threat. We are looking at, obviously, our own laser capability. We're looking at the capability of Soviet lasers, and we do not know all we would like to know about either one, nor do we know all we would like to know about our own on-orbit vulnerabilities, so, for me to say how serious a threat it is, the best thing I can say in that respect, is we're certainly studying it, considering it and concerned about it.

**MR. MACLEOD:** With a large projected growth in low earth orbit operations by many countries, as we heard yesterday, and expanded operations by U.S. military in space, are you concerned about the projected growth in orbital debris in LEO? If so, what do you think could be done about it?

**ADM. BREAST:** Yes, sir, I am concerned about it. One of the things we could do about it is to have a better space master computer in places like Cheyenne Mountain and other places. The continual cataloging of that space debris is an important aspect. We might even get some sort of international allied endeavor to go toward a better cataloging, and a better understanding of the low earth orbit debris belt that certainly exists, and will continue to exist.

The other thing we can do is to probably spread the wealth a little bit, about how to get rid of satellites without creating a lot of debris. If the United Nations sponsored activities along that line it might be healthy.

**MR. MACLEOD:** If there are battles or war in space — perhaps the decision-making affair as opposed to merely affecting ground war — how would we know what victory means, especially if it's bloodless?

**ADM. BREAST:** That's almost poetic, you know it? How would we know what victory means, especially if it's bloodless? General Piotrowski likes to say, war in space is interesting, but it's not compelling. And I think that's right, it's not compelling. Therefore, the bottom line of any conflict that even was initiated in the spatial arena would probably end up as a confrontation of ships at sea, or tanks on the desert or soldiers on the line, or a geopolitical confrontation across a round or triangular table at some third country position, or maybe even over some third country, emerging nation conflict.

So, just as we saw in 1962, with the Cuban crisis, and the blockade that occurred down there, there was very little blood shed, but there was certainly a confrontation where world leaders sat down, and decided and weighed the effect of different systems on their geopolitical status and strength and ability to continue to go ahead with whatever ploy they may have had.

I think that's what we'll see in space. Space will be a major leverage point in the next confrontation.

I can tell you without divulging any classified information at all, space was a major leverage point in the Gulf of Sidra in the Spring of 1986.

**MR. MACLEOD:** Admiral Breast, how much longer before we own up to military-in-space, combat service support and begin the requisite preparations for life support provisioning systems for military space operation?

**ADM. BREAST:** Well, of course, that's what I tried to say, and I want to again reiterate, my extraordinary respect for you gentlemen and ladies for what you're attempting to do. I think that the bottom line answer to this question is how much longer are we going to be able to tolerate a system which is, in fact, not forthcoming to the degree that we absolutely need for it to be, to be competitive, or to continue to be competitive in a wartime environment, with our major competitor. So I would ask the same question, and I can't begin to answer it.

**MR. MACLEOD:** Do you know of efforts to get our military representatives working with or meeting with Soviet representatives, on what level, and could a captain meet with any Soviet counterpart, just to get to know each other?

**ADM. BREAST:** I do know of efforts. I am not in a position to say on what level, and no, I don't think a captain could meet, unless, maybe, he was a Navy captain!

**MR. MACLEOD:** And with that, we want to thank Admiral Breast for coming here and speaking as candidly as he has. As you know, the Symposium features the decision makers in the policy area, as well as in the military, civil and commercial areas. We've had candid answers over the last couple of days, and you've certainly continued that well, sir.

**ADM. BREAST:** Thank you, Dick

# MILITARY SPACE R&D POLICY

*Moderator:* **Dick MacLeod**

*Speaker:*
**Maj. General Tom Brandt,** USAF,
Chief of Staff, Air Force Systems Command

**MR. MACLEOD:** So that we include both the research and development community, as well as operations, we have with us today Major General Thomas C. Brandt, who is Chief of Staff of the Air Force Systems Command at Andrews Air Force Base, Maryland, and as most of you know, the parent command of the Space Division.

General Brandt comes from Pennsylvania, and attended the University of Pennsylvania briefly before going on to the Naval Academy; he found his way to the right color uniform after that. General Brandt graduated from the Air Force Institute of Technology, Wright-Patterson in 1960, with a masters degree in electrical engineering. He also graduated from the Industrial College of the Armed Forces in '72 and the executive program at the Colgate Darden Graduate School of Business, University of Virginia in 1977.

*MAJOR GENERAL TOM BRANDT is the chief of staff Air Force Systems Command, Andrews Air Force Base, Md. He attended the Univerity of Pennsylvania, Philadelphia, in 1951. He then entered the U.S. Naval Academy, Annapolis, Md. He received a B.S. from the U.S. Naval Academy. He received a Master's degree in electrical engineering from the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio. He also graduated from the Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C., in 1972 and the executive program at the Cilgate Darden Graduate School of Business, University of Virginia Charlottesville, in 1977. General Brandt wears both the master space badge and master missile badge. His military decorations and awards include the Defense Superior Service Medal, Legion of Merit with one oak leaf cluster, Bronze Star Medal, Meritorious Service Medal and Air Force Commendation Medal. He was promoted to major general April 1, 1984, with date of rank Sept. 1, 1980.*

General Brandt has had a long and varied career as a non-rated officer in the Air Force. He has been involved with space activities for many, many years and is well-known for his assertiveness as a young officer and continuing as a Major General. We'll bring the assertive general up here now, Major General Thomas Brandt.

**GEN. BRANDT:** Now I have to be assertive.

I am pleased, as I always am, to be back in Colorado Springs. I have had the great good fortune in the course of my military service to spend 15 years here in various capacities, seven and a half of those in Cheyenne Mountain, that's why I blink in strong sunlight to this very day.

Today in representing the Air Force 0590 Systems Command, the premier space organization over these last 30 years in the U.S. Air Force, I would like to begin by quickly looking back, because I believe, like Shakespeare, that the past truly is prologue. Let me just go back in increments first to remind you that two years ago, after Challenger, there were other successive launch failures. You will recollect, Titan 34 D, there was also a Delta launch failure hard on the heels of those, and then the minuteman test failure sort of was icing on the cake, and everyone said things are going to pot; we are in deep trouble. Here we are now, just a little over two years later, and the picture is a lot brighter as we speak today. It's brighter because of the hard work of a lot of men and women, all the way from the Congress to those doing the hard work in engineering and the recovery that is now going on.

**Here we are now, just a little over two years later, and the picture is a lot brighter as we speak today.**

That recovery underway is probably going to take almost a full decade, around ten years, before it comes to its ultimate fruition, because it will involve not only the return of the shuttle service, but also things like the Titan 2, the Titan IV, the Delta II, the MLVs that are underway, so that we will ultimately have a mixed fleet.

Let me step back now, to earlier in this decade, when I was talking to Bob Cripin at another space symposium. This one was out west, it was at Monterey, California, and a little fellow came up. I had never met him before, but I had certainly heard of him, and he had a lot to say about space, following, as you recollect, October 4th, 1957, when I was a young lieutenant. That was the day, when military space operations began. It was the day on which Sputnik traveler was launched, and shortly thereafter in December of that year, that small man, already famous, had this to say; "And he observed," that is Jimmy Doolittle observed, "that the Soviet Union was not going to rest on arse," as we used to say in the Navy," but rather was going to pursue in a very relentless fashion this business which we call military space operations."

And that has occurred. So it isn't a brand new business, if you think of it in those terms, because last October we entered the fourth decade of military space operations, and it has been literally a hare and tortoise issue, back and forth over time, when we, with resolve, have made brave commitments, as we did in the case of John Kennedy and Apollo and certainly, we see Gen. Phillips here today. He recollects what national resolve can do, and what we as a nation can do in space.

Now, what about where we are now? In 1988, we have done a number of things, one of which starting the year is good, and that's to reaffirm policy goals for space.

I'm not going to review all of these today, but rather focus in the context of R&D on three initiatives that are currently underway, that are intertwined with this new set of National Space Policy goals.

First, I want to dwell for a few minutes on our launch responsiveness study, which has been undertaken this year and is about to be completed, to look at the issue of how are we postured and going to be postured to launch space vehicles. If you stop to think about how we've gone about that in the past, you will recognize that normally we have not developed space launch vehicles, but rather, adapted existing vehicles to launch things into space.

That is a fundamental change that may occur in the future when we begin to design space launch vehicles.

**Are the Soviets really ahead, and why don't we do what they do? I might say that why we don't do what they do is because fundamentally, we've had a different strategy across the years.**

I want to talk about the NS satellite programs that have been commented on, and then finally something about how we, in research and development, view our role as a catalyst in helping speed this process of commercialization of space. So we are beginning with responsiveness and looking at what were the concerns that brought about this look on the part of Air Force Systems Command and Air Force Space Command, to see what it was that we do today that takes so long to process a vehicle prior to launch, and then to check a satellite out, once it has been launched.

These concerns were probably catalyzed two years ago because of those disasters that I recounted, and the concern is the Soviets; have we lost the edge? Are the Soviets really ahead, and why don't we do what they do? I might say that why we don't do what they do is because fundamentally, we've had a different strategy across the years. We've exploited our high technology, and we've gone about very early on with missions that have a very long mean mission duration. So you can quickly, if you're looking at just the order of magnitude difference in launch rates between the two nations, assume that fundamentally, we're doing something wrong because we only launched ten times a year, they launch a hundred times a year; however, if you look at mean mission durations, I think part of the answer comes immediately into focus. That is we, the United States, have seen an extended mission duration on all kinds of functional capabilities that are space based, from the very early years of launching, and I'm talking about the early part of the decade of the '60s.

There is then a quality/quantity balance that has to be brought into focus if you are making, or attempting to make, a valid comparison between the two space orders of battle.

In the case of this study, we wanted, then, as objectively as we could, to validate a comparison between the two forces, and then look at our own situation and ask ourselves the questions, are there ways that we can improve, because certainly, no one is perfect. However, if you would listen to a lot of the criticism today, you would probably conclude that some of us sometimes fall victim to playing that old game of "Ain't it Awful?" If you recollect the book, a number of years ago, **The Games People Play,** "Ain't It Awful" is a very easy game to play, because sometimes it can be awful. You can always find fault, and sometimes overlook all the good things, all the great things that are associated with any venture, like the U.S. Military Space Operations venture.

Now, one thing, and I think Admiral Breast obviously touched on this, that we have to be concerned about is it may not always be peace time. As dependencies grow on space, dependencies, that is, on the part of our terrestrial forces, be they Naval forces or ground forces, then you have to worry about will it be there when I need it; what do I need, then, when I go to war; how can I endure the capability across a spectrum of conflict? These are all valid concerns, and they're concerns that the United States Space Command are addressing today, and I would put them all under the umbrella of, we, the developers. We, the research and development people, must be sensitive to the needs of our ultimate users for space-based systems, and that means we have to look at them in the context of operationalizing this business.

**History of air power might give us some small measure of insight into what the difficulty of that is for space.**

History of air power might give us some small measure of insight into what the difficulty of that is for space.

There's a fundamental difference and that is that you can see an airplane; you can't see a satellite normally, after you've launched it. The old adage of "out of sight; out of mind" may be really hindering us in the space business of getting fully integrated into our operating forces, this element of our order of battle that with each day becomes increasingly more important to our ultimate success in conflict.

These systems I show here are important, and the ones we focused on, in particular, because today they are under the operational control of the United States Space Command through its component, the Air Force Space Command, and you've heard about them earlier. But what we wanted to do along the way in the study is look at risks and costs associated with compressing the time that it takes to successfully process and launch a satellite.

The 1990's peace time launch mix that has been alluded to several times now, those various vehicles that are underway, and we're already spending the money and the contracts are already there, in most cases, that looks good to us as far as supporting the peace time launch schedules that are projected. But it certainly doesn't answer some fundamental questions about the durability of these force elements, should we go through crisis into some conflict level, whether that be the conventional level or ultimately some other.

Our bottom line of this study to date is that currently the space launch strategy, that is the near term one, seems to be working. At the same time, let me remind you that each day you and I come closer to a vision and understanding of a new century, a new century in which the demands upon us, militarily, may be different.

Now is the time to look at our technology base and nurture it to prepare for those days.

Time has a way of slipping by.

We must then today seize what we think is the vision of tomorrow.

We must get on with it.

We must get on with our commitment to remain a great nation, which means you have to have some venture capital. You have to invest for those who follow, and although times appear to be tough, financially, for defense in this country today, I would say that economically, the United States of America has no choice but to invest in its future; that we need to convince all of those who are decision makers that it is an imperative that we get on with the space business by taking those investments that are necessary up front, things like an advanced launch system.

**But those are the launch vehicles of the 1990s, and now is the time to be innovative and to place those investments, to look at the next century, the 21st Century, now less than a dozen years away.**

Let's talk a little bit more about space launch in response to this term then, of planning for the future.

Today, as I mentioned, is on contract. The reality of that will come about in its fullness not until the middle of the next decade. But those are the launch vehicles of the 1990s, and now is the time to be innovative and to place those investments, to look at the next century, the 21st Century, now less than a dozen years away.

Most of us, God willing, here right now, will see the dawn of that new century, and we must prepare now, not wait, not cavil, not make intellectual arguments that say we cannot afford this or that.

Space launch responsiveness from the operator's perspective, continuity of launch operations, is essential. We cannot give operators a peace time system and ever expect them to be content.

The simplicity of launch operations satellites is complex. Boosters that have been developed for ballistic missiles and then converted to space launch boosters have tended to be complex too, especially, I might add, those that are not solid. When I first met Gen. Phillips, he was a brigadier general. He was the minuteman program director, and the minuteman was our first real viable ballistic missile, in my view, and I had been involved in others, because it had a degree of simplicity in its design that allowed us to place it in the hands of operators.

**Space launch responsiveness from the operator's perspective continuity of launch operations, is essential. We cannot give operators a peace time system and ever expect them to be content.**

We must do the same thing, deliberately, we, the R&D people, through design, over time, to provide operators the wherewithal to operate these systems.

It has not been a good thing — this is personally, my view, not an official few — my view says it has not been a good thing to retain over those three decades or more, most of these systems, within the R&D community. I recognize all of the imperatives associated with that, and the complexity was part of it.

But we must now say deliberately that through R&D we will field systems, like an ALS, that will be tailored to be operated by operating forces.

What about antisatellites? Now, let me say, we've had antisatellite systems before in this country, and we didn't care too much, not as with the MHV which became such a political football in recent years, that despite a successful testing — in fact, they've only been allowed to test once. It was totally successful, so that's a 100 percent test success rate; unheard of, obviously. But for whatever reasons, it appears that this, the MHV is dead. However, you know that the Phoenix has a way of rising from the ashes, maybe in another form, in a reincarnated form, so it no longer looks like a sacred cow. I would predict that over time, because of the imperatives, as the Admiral discussed, of the war fighter to have an arrow in his quiver — he must have that, that's an imperative — that time and again, you will see the initiative by the military to develop some antisatellite weaponry.

What are the reasons? There are many reasons. Here are some of them. I won't go into all the details, but the operator will tell you, he wants to be able to protect his order of battle. He doesn't want to give the other guy a free ride. He doesn't want to be held hostage to someone else. He wants to be able to defend himself, that is only natural for the warrior to want to do that.

**It simply means that we, in the future, need to go forth, and rejustify antisatellite systems that make a lot of sense, and convince the Congress, obviously after convincing the Executive Branch.**

So now this most recent initiative, the miniature homing vehicle on an F-15, has been very recently, last month, canceled. That doesn't mean that the need, the requirement, the imperative can be legislated away or canceled.

It simply means that we, in the future, need to go forth and rejustify antisatellite systems that make a lot of sense, and convince the Congress, obviously after convincing the Executive Branch.

The miniature homing vehicle, the king, is dead, long live the king.

He must go on.

What about laser technology? I was talking to John Dare and he said, laser technology, what would he say about it? Well, there are lies, and there are big lies, and then what was it John, there are those laser designers who come in right along with the liars. I guess there have been a lot of promises, big promises that haven't been totally fulfilled and I would say that it is clear that laser technology has great potential for use in the role of antisatellite devices. I would say that lots of work has gone on. Look at the atmospheric compensation out in Maui. We are beginning to know how to do that, that seems to be one of the long poles in the tent, so I would say in thinking of weaponry for the next Century, because that's what we're talking about now, even if we got underway today, thinking of things for the next century that a laser-based technology kind of system in the offing would be part of the solution for wanting to defend our space.

Now, let me go out on a limb.

Many generals in the past have gone out on limbs.

This guy said these words right before a cannonball took off his head — I'm looking around, I don't see any cannons — however, it is dangerous, as you know, to even predict what's going to happen this afternoon, let alone in the future, but let me try to describe what I think is some emerging antisatellite road map.

I think it will be a mixed force kind of emergence, that we'll see more than one thing proposed, just as we've seen the solution of ELVs be a mixed force solution.

I believe we'll see some kind of kinetic energy interceptor proposed and then also some kind of laser device proposed. There is currently this general officers steering group, which is at the DOD level that is going to wrestle with that, and I'm just telling you that I believe they'll come out with some balanced kind of proposal that will have the various elements in it.

**We in the Air Force Systems Command, in the research and development business, view ourselves as both buyers and providers of launch services, and we think we're going to have an important role in this initiative for the commercialization of space.**

Now I show again the MHV configuration, but I've already told you I don't think that's what's going to come out of the pipe at the time. I believe it's going be something else. It will be a kinetic kind of defense, a hit-to-kill, if you will, conventional, and also some kind of a laser device emerging in that time period, and notice I'm showing the development time leading to deployment, and that's taking us out into the next century.

What about the commercialization of space? We in the Air Force Systems Command, in the research and development business, view ourselves as both buyers and providers of launch services, and we think we're going to have an important role in this initiative for the commercialization of space.

As you're aware, back in 1984, we had the Commercial Space Launch Act.

I can remember those years, when I was Director of the Joint Planning Staff for Space in the office of the joint chiefs, that I represented the joint chiefs and the interagency group, along with Mr. Taft. He and I represented defense. And in looking at things like the commercial issues and shuttle crises policies and so on, I want you to know that the military is fully supportive of commercialization of space, and you would ask yourself why?

Well, because we understand history.

**The time seems exactly right now to encourage an emerging space launch industry.**

Because we know that there are a lot of U.S. satellites in peace time which would have great utility in war time.

And we would like to see a robust commercial U.S. presence in space because of the potential it could add to our national security.

Healthy industry, successful industry, is good for our national security and we need to keep that perspective, and we, the military, want to do what we can within the law to support the initiative, to have a healthy market for launch vehicles, a commercial market, if you will.

The time seems exactly right now to encourage an emerging space launch industry.

In the Systems Command, we have traditionally acquired launch systems and, I would submit, done a very fine job over those decades — people like Gen. Phillips — in doing that.

We now are also called upon to make available at cost, launch facilities in both east and west coasts for commercial launching, and that is going to happen. We fully support that, and the Secretary touched on some of that initiative earlier today.

One of the things we've done — I won't go into it in detail— like the MLV for Discus which we are currently acquiring, because that's in source selection, but I would remind you all that that RFP, request for proposal, manifests our attempt to skinny down bureaucratic procedures. We've reduced that scale by about one order of magnitude, and that drives the industry teams in the right direction, as I see it, in being able to do likewise on their part, as they respond to that.

Now, in looking at our bottom line of national security, let me go on a moment and talk about us a little more as a buyer.

We have bought consistently for government use, but we have bought, obviously, from industry. We don't have a lot of arsenals left.

So, as a provider of launch services, we are exploring some new ground here. We're serious about it. We're working, but it's DOT, the Department of Transportation that's in the lead here. We are supporting characters in this cast. That's a different role for us.

We want to do whatever we can to encourage that commercialization and we are working, in particular with DOT, in determining insurance arrangements. That seems to be one of the longer poles in the tent, and we're doing that now.

So finally, let me say a word about the future. We're right here on a frontier, here in Colorado Springs, where all of the above is happening in space.

Military men have been there from the beginning, just as were Lewis and Clark, Fremont, Powell, Zebulon Pike, right here and after them, who came? The John Chisolms, the Cornelius Vanderbilts, the John Jacob Astors, the Greenville Dodges, and they commercialized and laid claim to the area. We must do the same thing with space.

In today walks tomorrow. Thank you.

**MR. MACLEOD:** The General actually covered the series of questions that had been written, so we will not have a Q&A at this point.

# Planning Research Corporation and NASA . . .
# An Ongoing Partnership

Planning Research Corporation (PRC), for over 25 years, has provided NASA with the professional engineering, scientific, and information services needed to direct our nation's space program. Our continuing support has created a corporate culture and professional work force that is dedicated to meeting the changing demands of NASA's ongoing mission. This dedication is reflected by the commitment and flexibility in the attitude of our people — our major resource — to provide responsive service — our only product.

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# EMERGING SPACE TECHNOLOGIES

*Moderator:* **Dr. Pieter Frick,** Dean of Engineering College, University of Colorado, Colorado Springs

*Speakers:*

**Richard Horton,** Director of Marketing, Ramtron Corporation

**Dr. Toshi Fujiwara**, Department of Aeronautical Engineering, Nagoya University, Japan

**MR. MACLEOD:** If Dr. Frick is available, we'll go ahead with the next portion of our program. Dr. Pieter Frick came, during the past year, to the University of Colorado at Colorado Springs from Oregon. Dr. Frick originally was from South Africa. He has taken over the engineering college at UCCS with a lot of vigor, and has been involved in a number of entrepreneurial efforts, as well as those in stimulating new technologies.

I will present at this time, to introduce our emerging space technology speakers, Dr. Pieter Frick.

**DR. FRICK:** Thank you, Dick. Ladies and gentlemen, contrary to popular belief the City of Colorado Springs has, over the last five to eight years, become the focal point for solid state and integrated circuit technology in the State of Colorado, if not for the entire Rocky Mountain region.

> **Ferroelectronics is a technology that has the unique ability to make modern microelectronic functions — chips, if you will — extraordinarily high-speed, non-volatile and very tolerant to the severe and harsh environments of the aerospace industry.**

Today, we are focusing attention on one of the brand new projects that is just coming to fruition over the last three years. The College of Engineering at the University of Colorado here in Colorado Springs, has, in conjunction with a start-up company, pioneered a new technology for producing radiation and a non-volatile integrated circuit. Two and a half months ago we announced the first product, a FRAM, into so-called ferroelectric technology, a brand new version. We take great pride in this development, particularly since it drew the attention of representatives from every major aerospace company in the country.

It is also fitting that we introduce a person from Ramtron Corporation, the private company involved in this joint venture, a misplaced Bostonian who got totally lost. He is an electrical engineering graduate from SMU. He earned a B.A. from Pepperdine University. He's a 20-year veteran of the silicon business. It gives me great pleasure to introduce to you Mr. Richard Horton.

**MR. HORTON:** Thank you, Pieter. Good day. For those of you who may have been present at the Space Symposium of 1985, you may recall that a new technology — a joint research program between the University of Colorado at Colorado Springs and Ramtron, a new business venture — was announced and its research goals defined. It is now almost three years later, and I return today to report on the results of that research. It has emerged from the laboratory. It is going to commercialization. That is my subject for the next 10 to 12 minutes. The name of the technology is ferroelectronics. Ferroelectronics is a newly-coined word which specifically describes the merger of two dissimilar areas of science: the science of ferroelectric materials, which were discovered in 1921, and microelectronics, which we know as silicon integrated circuits or chips, as they are popularly referred to. The technology is out of the laboratory. It is working. It is real-world today. The relevance to this conference is that ferroelectronics is a technology that has the unique ability to make modern

*PIETER A. FRICK is the Dean of the Engineering College at the University of Colorado in Colorado Springs. Frick served in the South African Air Force from 1960-1967. Frick has worked for the South African Iron and Steel Corp., was an Assistant and Associate Professor of Electrical Engineering at Oregon State University, and was a Professor and Department Head of Electrical Engineering and Computer Science at Portland State University. Frick received a B.S. and B. Engr. from the University of Stellenbosh in South Africa, a M. Engr. from the University of Stellenbosh in South Africa, and a DIC., Ph.D. from Imperial College, University of London.*

*RICHARD HORTON is Director of Business Development for Ramtron Corporation and is responsible for sales, applications engineering and marketing. Previously, Horton was Director of Business Development for Honeywell's Solid State Electronics Division; President and Chief Executive Officer of Lawrence-Crow Electronics, Inc., an international engineering consulting and marketing company; and was employed by Texas Instruments in a series of engineering, marketing and business management positions within their semiconductor components group. He completed Pepperdine University's Presidential/Key Executive MBA program as well as a variety of undergraduate programs and is a veteran of the U.S. Navy.*

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RAMTRON
CORPORATION

**RAMTRON CORPORATE PROFILE**

- Founded in May 1984 to Achieve Technical and Commercial Leadership in in the Application of Ferroelectric Materials to Nonvolatile Semiconductor Based Products
- Privately Held U.S. Corporation Registered in Delaware
- Located in Colorado Springs, Colorado
  -- Offices at 1873 Austin Bluffs Parkway
  -- Research Lab at University of Colorado Microelectronics Center
- Current Personnel Total 40 (32 Engineers/Researchers)
- 1988 Sales Forecasted at $5 Million
- 40,000 Square Feet Research and Manufacturing Facility Planned for 1989 Completion
- FMx 801 FRAM™ Technology Demonstration Vehicle Available for Qualified Customer Evaluation

microelectronic functions — chips, if you will — extraordinarily high-speed, non-volatile and very tolerant to the severe and harsh environments of the aerospace industry. This simply describes Ramtron as a venture. I think the only point I would make here is that Ramtron is a research and development organization of 40 people, 32 of whom have advanced engineering degrees.

In the past three to four years, ferroelectronics has shifted very heavily from the research side to the development side, which means solving real problems in the real world today, and we are doing it. We have named it; it's something new under the sun. It's called a FRAM for Ferroelectronic Random Access Memory. FRAM is a radiation-hardened, extraordinarily dense memory technology that is high-speed and non-volatile. And that is what I'm going to describe to you.

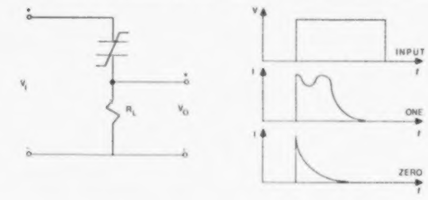
There is a fundamental new invention at the heart of this. We just recently named it the Digital Memory Capacitor. For those of you who have some background in electronics, you may recognize that the storage of binary information — or the binary number system which all modern computers use for coding — requires a plethora of components to implement. This new component stores with a bistable element. It stores the digital information at the molecular level; it is a molecular phenomenon. The single element of the Memory Capacitor, if you will, is a storage element of and by itself, and it is the basis of the invention that I'm going to describe to you.

RAMTRON
CORPORATION

**FERROELECTRIC FUNDAMENTALS**

**Since Their Discovery in 1921, a Number of Polar Dielectric Materials Which Retain a Direction of Spontaneous Polarization Following Removal of an Applied Electric Field Have Been Identified. Materials Exhibiting this Property are Known as Ferroelectrics, by Analogy with Ferromagnetics, without Implying any Connection with Iron Based Materials.**

*Schematic and Currents for Ferroelectric Digital Memory Capacitor*



It is not new, in the sense that we are not the first people to attempt to do this. Throughout the 1950s, the 1960s, and up until the early 1970s, much research was put into ferroelectricity as a memory technology, along with ferromagnetism. Ferromagnetics were the first to be made practical, and were used for computer memories through the 1960s. Today they are used in aerospace defense systems. Magnetic technology is still at the center of most tactical, certainly strategic and aerospace systems. This is what they tried to do with ferroelectrics in the 1960s. It simply didn't work. IBM, Westinghouse, General Motors, the Delco Systems Division

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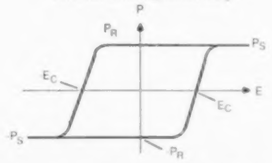
**FERROELECTRIC FUNDAMENTALS**

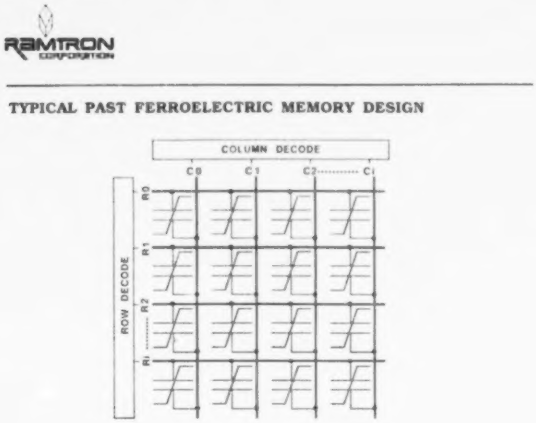
*Ferroelectronic Hysteresis Loop*



- **Spontaneous Polarization of Planar Ferroelectric Material Results From an Inherent Asymmetry Within Basic Crystal Cellular Structure**
- **Asymmetry Gives Rise to Ionic and/or Electronic Forces which Create Elemental Dipole Moments**
- **Dipole Moments are Additive Due to Cooperative Effects Yielding a Finite Polarization**
- **Polarization Cannot be Directly Read nor Destroyed by Short Circuiting Due to Rapid Charge Compensation within Ferroelectric Material**
- **Remanant Polarization ($P_R$) is Permanent Until Opposite Coercive Voltage Threshold ($E_C$) is Crossed Reversing Polarization.**

tried it. Bell Telephone Laboratories tried it. It simply didn't work.

The problems in those days was that science simply hadn't advanced to the point where they understood the mechanisms or had the tools available to create a solution to the problems that plagued them. This is an analog in ferroelectric storage cells to core memory, or magnetic storage which was what was understood well in the 1960s.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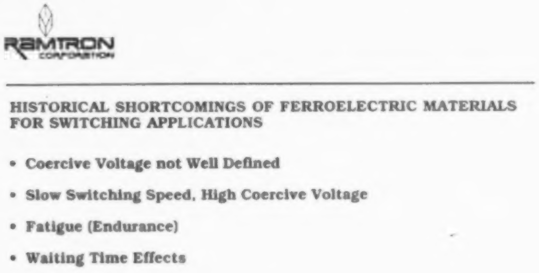
TYPICAL PAST FERROELECTRIC MEMORY DESIGN

The reasons it didn't work are listed here and in about 35 pounds of paper documenting three decades of research. I won't belabor the point. These are very simple pragmatic problems in terms of observation, but in terms of solution, the solutions evaded the technologies of the 1960s.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HISTORICAL SHORTCOMINGS OF FERROELECTRIC MATERIALS FOR SWITCHING APPLICATIONS

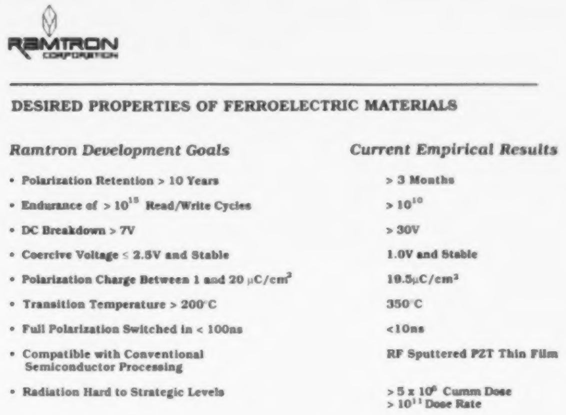
- Coercive Voltage not Well Defined
- Slow Switching Speed, High Coercive Voltage
- Fatigue (Endurance)
- Waiting Time Effects

This basically describes where we started in 1985, in conjunction with the University of Colorado at Colorado Springs.

The very first thing obviously, given any classical engineering problem, is to define the parameters and the criteria that must be met in order for a successful solution to be implemented.

On the left-hand side are those parameters, not of perfection, but the parameters of utility, the thresholds that would have to be met by a research effort.

On the right, we are showing the current capabilities as of April 14, 1988. This says that ideally you would like to have a memory or an electronic function that approaches the speed of light and that is extraordinarily dense. Obviously, scaling to the molecular level or even the atomic level would be an objective of the technology. You want something that's extremely robust, that will withstand severe environments such as radiation and extreme temperatures, and you want something that is affordable for the end-user.


RAMTRON
CORPORATION

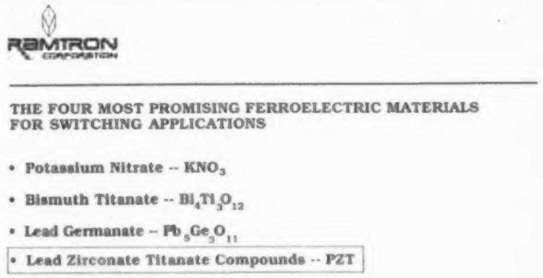
DESIRED PROPERTIES OF FERROELECTRIC MATERIALS

| *Ramtron Development Goals* | *Current Empirical Results* |
|---|---|
| • Polarization Retention > 10 Years | > 3 Months |
| • Endurance of $> 10^{15}$ Read/Write Cycles | $> 10^{10}$ |
| • DC Breakdown > 7V | > 30V |
| • Coercive Voltage ≤ 2.5V and Stable | 1.0V and Stable |
| • Polarization Charge Between 1 and 20 $\mu C/cm^2$ | $10.5 \mu C/cm^2$ |
| • Transition Temperature > 200°C | 350°C |
| • Full Polarization Switched in < 100ns | <10ns |
| • Compatible with Conventional Semiconductor Processing | RF Sputtered PZT Thin Film |
| • Radiation Hard to Strategic Levels | $> 5 \times 10^6$ Cumm Dose<br>$> 10^{11}$ Dose Rate |

Without going through each of these, essentially what we are describing in terms of the current empirical results after four years of research is that we have either met, are progressing towards (as in the case of tests for which we obviously don't have ten years of log time), or have achieved all of the threshold criteria for the technology. It is extraordinarily fast, extraordinarily dense. It is very robust and withstands very high levels of radiation. We have accomplished all of this using what is a relatively conventional manufacturing technology within the semiconductor industry, that is, sputtering technology.

Ironically, the materials that we are using are of the same family as warm superconductors. These materials are Perovskite crystals, ABO3-type polycrystalline structures. While doing our research here in Colorado Springs, we have been somewhat amused by the progress report of the warm semiconductor industry, because the film and deposition techniques and the electroding techniques that have been developed in warm semiconductors and announced recently are essentially what we have been researching for four years. It's enjoyable for us to stand up and talk about it now.

There are over 700 ferroelectric materials which have been discovered since 1921. They were misnamed: There is no iron, no ferro in this material at all. They were misunderstood for about five decades. But of the 700


RAMTRON
CORPORATION

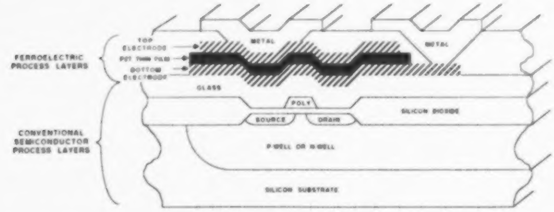
THE FOUR MOST PROMISING FERROELECTRIC MATERIALS FOR SWITCHING APPLICATIONS

- Potassium Nitrate -- $KNO_3$
- Bismuth Titanate -- $Bi_4Ti_3O_{12}$
- Lead Germanate -- $Pb_5Ge_3O_{11}$
- Lead Zirconate Titanate Compounds -- PZT

materials, four of which we concentrated our research on locally, one family of compounds has made remarkable progress in the past year. It is a family that includes lead, zirconium and titanium as its primary elements. As I said, it is ceramic that we sputtered as a thin film, and it is a Perovskite-type polycrystalline structure. All of the data I'm going to show you now is from the family of compounds we fondly refer to as PZT.

RAMTRON
CORPORATION

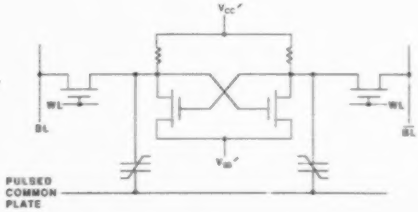
**PZT THIN FILM ON CMOS**



That's how we built it. For those of you who might have looked at chips or are familiar with silicon chip technology, you probably will recognize that it looks like silicon chip technology, and, in fact, it is. On top of the conventional silicon substrate, which is shown as the first seven or eight layers from the bottom, we have successfully engineered a technology that allows us to build a ferroelectric sandwich. It is metal, then ferroelectric (which is PZT), then metal again on top. We interconnect the entire circuit. Notice that it is a three-dimensional structure. It takes no incremental area. It's built stacked vertically on top of an active silicon device.

RAMTRON
CORPORATION

**FERROELECTRONIC SRAM BASED MEMORY CELL**



That's a circuit. It may not mean a lot to some of you, but what it says is that the two elements at the bottom with the diagonal lines across them are ferroelectric capacitors. We succeeded in integrating them directly into an active CMOS static RAM circuit which is shown on top. So we have taken what exists now and dramatically upgraded or improved it. The advantage is that you don't have to re-engineer the world. Systems as they exist today can be directly upgraded to this technology without investing re-engineering or recapitalization.

RAMTRON
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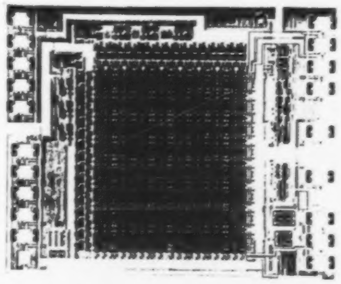
**256-BIT FERROELECTRONIC NONVOLATILE RAM**

*FM 801 Demonstration Product for Ferroelectronic™ Random Access Memory (FRAM™)*



That is the world's first ferroelectric random access memory. We succeeded on our third try just before Thanksgiving 1987. We had fully-functional characterized units by Christmas. We have been building these here in Colorado Springs for about four and a half months now. Many aerospace defense companies have these units in their hands, and they're currently in characterization and evaluation for systems applications.

RAMTRON
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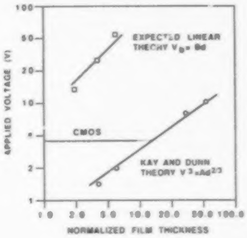
**PZT FILM THICKNESS vs APPLIED VOLTAGE**



These are really brief. This simply says that it is a true variable voltage technology. In the graph on the left, the line plot is the theory, and the data points plotted are reality. What we are showing is a very low voltage, low

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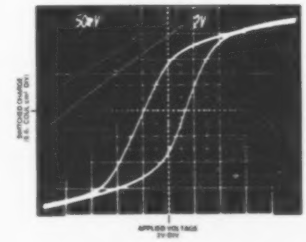
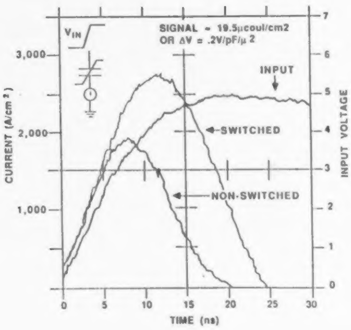
**PZT THIN FILM HYSTERESIS LOOP**



energy phenomenon which makes it fully compatible with modern microelectronic systems. The upper plot shows the dielectric breakdown, which means the ability to withstand high-energy pulses. The dielectric breakdown here demonstrates that it is a very robust, rugged material. It is a ceramic.

That's a hysteresis loop. It is electrical characteristic or a property of the devices we are describing. There is some iron in here, but the important data points are that the loop existed in the 1960s. We didn't change the physics of the device. We just applied them in a very pragmatic manner.

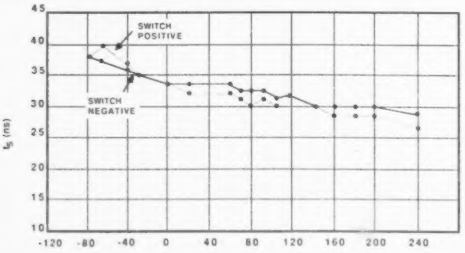
**PZT SWITCHING TIMES**



It shows the technology switching at one and a half volts threshold, and it shows that the technology is fully saturated, which means the material is fully polarized. That is a write cycle for those of you familiar with computer operations. The write cycle is completed with less than five volt potential across the material, which is true low voltage technology.

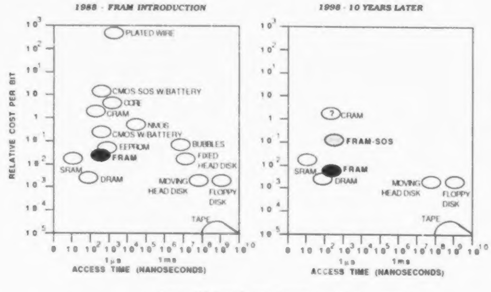
This shows the switching speed. Not only is it very low voltage and low energy, but it is an extraordinarily fast phenomenon, a unique feature of these materials.

**PZT SWITCHING SPEED VS TEMPERATURE**



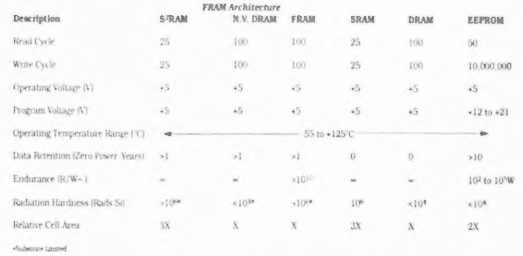
This graph on the bottom is nanoseconds, trillionths of a second in switching speed. The input waveform at the 50 percent point shows that it takes about seven nanoseconds to reach the trigger or the threshold point. The far right waveform shows that the write cycle is completed in 17 nanoseconds, giving an elapsed time of ten nanoseconds, ten trillionths of a second, to switch or write data to the material. The read cycle is the inside waveform. It shows approximately five nanoseconds to sense or read the state of the cell. The material will run, even in its current form, at over one hundred million cycles per second, as fast as the fastest signal processors in aerospace use.

**FRAM™ IMPACT**



(Source · U.S. Naval Surface Weapons Center · By permission)

**READ/WRITE SEMICONDUCTOR MEMORY ALTERNATIVES AT 1 MICRON**



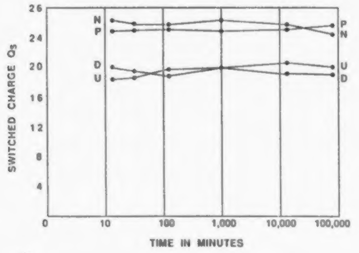
| Description |  | FRAM Architecture |  |  |  |  |
|---|---|---|---|---|---|---|
|  | S³RAM | N.V. DRAM | FRAM | SRAM | DRAM | EEPROM |
| Read Cycle | 25 | 100 | 100 | 25 | 100 | 50 |
| Write Cycle | 25 | 100 | 100 | 25 | 100 | 10,000,000 |
| Operating Voltage (V) | +5 | +5 | +5 | +5 | +5 | +5 |
| Program Voltage (V) | +5 | +5 | +5 | +5 | +5 | +12 to +21 |
| Operating Temperature Range (°C) | ← -55 to +125°C → |  |  |  |  |  |
| Data Retention (Zero Power-Years) | >1 | >1 | >1 | 0 | 0 | >10 |
| Endurance (R/W- ) | ∞ | ∞ | >10¹⁰ | ∞ | ∞ | 10² to 10⁵W |
| Radiation Hardness (Rads Si) | >10⁶* | <10⁴* | >10⁶* | 10⁶ | <10⁴ | <10⁴ |
| Relative Cell Area | 3X | X | X | 3X | X | 2X |

*Substrate Limited

This shows the temperature stability of the switching phenomenon as a function of temperature. Here again, we are limited by what we can do in a laboratory. The actual capability of the material far exceeds our measurement capability. This shows that the material is very stable and has a slight positive temperature coefficient across an actual range of minus 80 degrees Centigrade — well below the minus 55 degrees Centigrade lower limit for aerospace — to above 240 degrees Centigrade. On the low end, our test lab froze up. On the high end, our jig was starting to soften and melt. We simply couldn't go to higher temperatures in the lab. The actual

Curie temperature point, which means the phase change for this material from a ferroelectric to a pyroelectric phase, is approximately 350 degrees Centigrade. We stopped because it was far beyond what any application required.

**PZT DATA RETENTION**

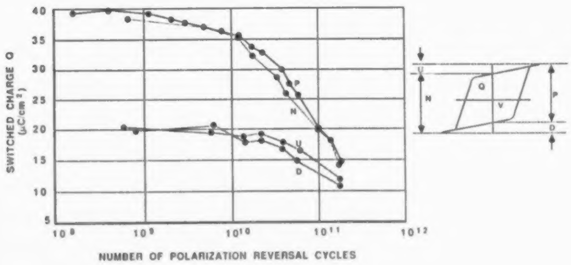


Here we're showing the issue of retention, and the issue here is that this is a non-volatile technology. It is quite unique as a semiconductor technology. If any of you have ever had lightning strike while you were watching TV or working on a personal computer, you know that you lost whatever was in active memory when the lightning strike occurred.

Obviously, in a space shuttle or an aerospace application, this could be a life-threatening or mission-critical occurrence. This technology is immune to power failures. What we mean by that is that at any moment, any instant when a power failure occurs, this technology is polarized to a permanent remnant polarization state. So anytime power is interrupted, it makes no difference. You simply wait a day, a week, a month, a year, ten years. Come back. Whenever you can power-up the system, the system will come up at precisely the state it was in when it went down. You don't have to reboot it; you don't have to reload it. No mission parameters or coordinates have been lost.

We have not been around for ten years, so our longest running tests are just through a hundred thousand minutes without power. Those are the increments, and, as long as those lines remain parallel, you have no loss of signal. We're actually now a little bit over four months on this test, but the next measurement point is a million minutes, and that's next year.

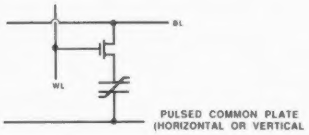
**ENDURANCE (FATIGUE)**



This is the issue of fatigue or endurance or wear-out. The question is: Does this phenomenon last forever? Unfortunately, as we should know, nothing literally lasts forever. A constant of nature is change. This says that the retention energy is flat to a million cycles of operation.

After about ten billion cycles of operation, you have lost 50 percent of the switching energy. To give you a comparison to current semiconductor technology, current semiconductor technology is about 1/200th that energy after the same number of cycles. So the point is: We are continuing the tests. The material is extremely robust, and the signal is better than two orders of magnitude greater after ten billion cycles than conventional semiconductor technology.

**ADVANCED FRAM™ CELL SCHEMATIC**



What I showed you is where we are today. The technology is very much in its infancy in the laboratory of UCCS. This is the next generation technology. We call it the advanced FRAM. Again, for those of you who might remember back, the early schematic I showed you had eight components in it. This is a two-component cell. We have just ordered our first tooling to start building this, and we will be running material here at the University within the next 60 days. This is a one-transistor cell. It has the density equal to or greater than the densest semiconductor technology today, which is that of a dynamic random access memory. Yet, this technology is fully static and fully non-volatile, and it has about a third fewer manufacturing steps. This is the future.

And this is the roadmap we have been following. To the lower left at the bottom, which you can't see, is the year 1984 when we started. 1988 is about the middle of the graph which is where we are today. We have increased over about six magnitudes of performance improvements during this period. To the right of the graph is the late 1990s, as we enter the 21st Century. It says that not only are we, as we are currently doing, expanding the state of memory technology using ferroelectronics, but also that we are providing solutions and

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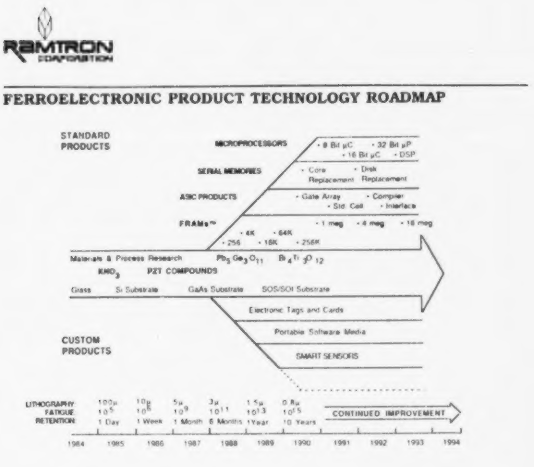

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FERROELECTRONIC PRODUCT TECHNOLOGY ROADMAP

upgrading literally all forms of current solid-state microelectronics, i.e. microprocessors, memory forms (such as solid state disks), ASIC products (which are things like gate arrays), and standard cells.

We are also, at the bottom half of the graph, applying it to end product applications. We're currently developing a family of electronic ID tags and smart cards — credit cards, if you will. Not only is this technology applicable to aerospace and defense applications, but it is also applicable to many of the major markets in the commercial area.

We are four years into it. It is a pleasure to stand here today and report the results. But, frankly, we are still in our infancy. It is the future that this technology is about. The point is that we are now to the phase of applied development, solving real problems in the real world.

Thank you very much for your time. I enjoyed speaking to you today.

**DR. FRICK:** As one of 20 to 30 million Europeans that stayed up all night a couple of nights in the late '60s to watch Neil Armstrong land on the moon, I've also had a fascination with these big cigar-shaped objects, actually, they're bombs that we detonate systematically to propel our people into space, and it's therefore appropriate, I think, that the second talk of this session is on propulsion.

Our speaker today comes from the other side of the Pacific, Dr. Toshi Fujiwara from the University of Nagoya, in Japan. He received all of his education from the University of Tokyo. He is currently a professor of aeronautical engineering, and Director of their propulsion laboratory. It gives me great pleasure to introduce to you, Dr. Fujiwara.

**DR. FUJIWARA:** Thank you, Dr. Frick. Ladies and gentlemen, this is my first time attending this meeting. It is a great honor to be invited as a speaker. I am truly grateful to the U.S. Space Foundation, and at the same time, to Apple Enterprise of Japan who strongly suggested and supported my attendance in this meeting.

Since my major field of research is in Nagoya University, hypersonic reacting, or real gas dynamics, I agreed to talk about some research activities currently going on in my laboratory.

I must request you to excuse me in talking slightly to academic subjects, rather than reviewing the research on this field in Japan or worldwide.

*Doctor - Professor TOSHI FUJIWARA is a Professor of Aeronautical Engineering at Nagoya University in Japan. He has also taught at Tokyo University. From Tokyo University, Dr. -Professor Fujiwara has received Bachelor of Science, Master of Science, and Doctor of Science Degrees in rocket propulsion, heat control of rocket fuselage and aerodynamics.*

However, since we are in a national university with strong ties with ISAS, the Institute of Space and Astronautical Sciences in Japan, under the Minister of Education, and in addition, since our city Nagoya is the center of the aerospace industry in Japan, represented by Mitsubishi, Kawasaki and Fuji, for example, our basic research is funded by those organizations to some extent.

Although my title simply says laser propulsion, in this presentation I want to talk about two materials as examples. The first is laser supported shock wave as it relates to propulsion, and, second, oblique detonation as an extreme combustion mode in a hypersonic ramjet engine.

We first consider that a small spherical plasma exists at time equals zero. It can be generated by an electric discharge.

Now, this plasma is irradiated by laser from all directions uniformly. Then the laser is absorbed into the existing electrons by Inverse Bremsstrahlung, IBS, producing a strong spherical shock wave, propagating with speed on the order of 50 kilometers per second.

Once this shock wave has started propagating, electrons can be generated by the thermal equilibrium in the enormously high temperature region behind the shock wave.

If we observe a sector of the spherical geometry, then the configuration becomes more realistic for application purposes. First, propellant gas is injected into the nozzle, then we generate a small plasma at the center by discharge, for example, followed by the irradiation of laser.

The detailed mechanism of generating a laser plasma is now summarized into this simple picture. Incoming molecular hydrogen is heated up by the shock compression, producing electrons, enough to absorb some laser power. The electrons are excited by Inverse Bremsstrahlung, IBS.

This excited electron collides with a neutral hydrogen atom, excites it, and eventually causes ionization.

The newly generated electron, again, participates in the absorption laser through IBS action.

There, of course, exists reverse processes like Bremsstrahlung, de-excitation and recombination from ionization back to neutron elements.

Thus, the fundamental equations we want to solve are essentially these seven. Mass conservation, momentum energy, those are overall conservation equations, and the remaining four are species equations.

We presented, for example, by ground level atom conservation, and excited the second level atom conservation, electron conservation, and electron energy conservation, and this electron energy conservation was very important, it turned out, because when we assumed the temperature of the electron equal to the temperature of an atom, then we needed an enormously huge amount of laser.

This problem is characterized by its spherical symmetry and non-steadiness. In the process of solution, we needed a number of physico-chemical properties, chemical rate constants and justifiable assumptions.

Analysis was first applied to a plain, not spherical, just a plain one-dimensional steady propagation of a shock wave supported by laser absorption.

The relation between shock velocity and laser intensity is in good agreement with Raizer's purely theoretical result.

The thickness of the absorption region, that is in the right-hand side behind the shock wave, becomes minimum at the shock velocity at about 50 kilometers a second.

This shows that at higher temperatures, IBS, Inverse Bremsstrahlung is not an effective mechanism to absorb laser.

We have obtained only the first phase of the absorption process that we can call ignition, and then we can probably obtain propagation.

This is a profile of the electro- density and pressure in radio direction with time varied from zero to something like a hundred nano- seconds.

Initially, electrodensity was limited to the central region, and then when time goes by, the electrodensity widens.

This shows that now plasma is ignited by the absorption of laser.

Now, we can see slightly lower electrical concentration and lower pressure buildup; however, the ignition of the plasma by the absorption laser is clear.

The results I have shown so far were based upon the assumption that the electron temperature was the same as the atom temperature, therefore, we needed an enormously high laser intensity; but we use separate energy conservation for the electron, then, the laser intensity was greatly lowered by the order of six, which is close to the practical intensity of the laser.

We still were able to obtain the ignition of the plasma.

I want to come back to standing oblique detonation.

We have a detonation holder, which has a radius of curvature, and in the detonator holder, we have a hypersonic flow which is greater than, for example, 4.8, which is the velocity of the mixture incoming into this holder.

In this case, when we use hydrogen plus air, which is the case of scramjet engine, then most likely the capability of the detonation which can propagate against the incoming air stream is about 4.8, therefore, we know that to establish a standing oblique wave, we have to have the hydrosonic flow mach number greater than 4.8.

We also assume the incoming temperature, 300 K, although in the real scramjet engine, the air flow in the combustor has already gone through many weak shock waves, therefore, the temperature will be slightly higher than 300 degrees Celsius, about 600 to 700 degrees Celsius in the case of hydrogen air. Now, in this case we have from our many previous years of experiment, shock wave in front of the holder, followed by the reaction front.

The important issues of the problem are whether the shock wave and the reaction front are coupled or decoupled. When we have a coupled wave, then we can see this is a detonation, and also we can have this kind of combustion mode as a safe and reliable engine. And another thing is whether the flow is steady or non-steady, because in normal detonation, we always have a nonsteady range.

Therefore, what is the most important parameters, which can affect coupling or decoupling and also steady or non-steady?

They are mach number, or radius direction or mixture ratio, or incoming temperature or something else. With this calculation for incoming Mach Number 6 which is certainly greater than 4.8.

The left-hand side, the calculated result is for non-reacting gas. This is just beyond oblique shock wave.

The right-hand side is a solution for the active gas.

Now, you can clearly see the shock wave is completely decoupled from reaction front, right after the flow passes the shoulder of the holder.

Now, the incoming flow mach number is increased from 6 to 10, for the same radius of collagen.

When the decoupling is taking place about twice of the diameter, compared with the previous one, mach Number 6.

Still, we can see the decoupling between shock and reaction front. We now changed the diameter of the holder twice.

Now, increased the diameter of the holder from 5 to 10, non-dimensional. The interesting thing is the shock wave is a big shock wave, however, the reaction front is totally non-steady.

This is more clearly seen in this picture, which is shown for different times, three different times that you can see, three different positions and shapes of the reaction front, compared with the left-hand side solution. Left-hand side solution is for the same mach number, Incoming Mach Number 6.0, however, the holder is one-half of the right-hand side. So the result shows when we increased the detonation holder, then we have a more violent noisy detonation compared with small holder.

However, the small holder may not be able to have a completely coupled wave which we still don't know, because we haven't done the complete calculation.

This is the typical detonation wave propagating in a channel. A channel detonation wave always has such three dimensional, in this case, two dimensional configurations.

In this calculation, also, the detonation propagating from below to above is fixed with the channel. The front has a very irregular shape. This is also observed in the experiment.

In an experiment down in the laboratory using a simulated oxygen mixture, this is the case of impounding the detonation, importing it from the center, and this open exposure picture also shows that the irregularity of the front, because you can see the spiral, such trace of the high energy point.

Therefore, we are also able to see in the standing detonation mode, an irregular detonation.

As a conclusion, we obtained for a small size, probably, the oblique detonation is decoupled. The coupling can be influenced by different parameters, and the flow, in this case, is more or less noisy.

Thank you.

**DR. FRICK:** Thank you Dr. Fujiwara. We will now adjourn for lunch.

# LUNCHEON

Sponsored by: Digital Equipment Corporation

*Moderator:* **Gen. James E. Hill,** USAF (Ret.)
Chairman, U.S. Space Foundation

*Speaker:*
**Dr. James C. Fletcher,** NASA Administrator

**MR. LARRY HOLMBURG:** Good afternoon.

In space, the standards are obvious. In our business, there was no mini computer business for 1957. We're proud to be part of that; we're proud to have grown as a partner in the space effort of this country and in the world, and to set some standards in our industry.

Our company has been the fastest growing company in the history of free enterprise, to the point where we're the second largest computer company in the world. We're fortunate to be part of an industry that is the fastest growing industry in our economy and that is truly world renowned.

We're now competing in an arena that many people in our country didn't expect to see a few years ago; it's here right now. This industry is expected to be as much as 20 percent of the Gross National Product for our country by the turn of the century. So it's a significant industry and we are proud to be a part of that.

In this industry, we've experienced a lot of technology transfer. Some of the recognitions given last night were excellent examples of the technology transfer in space. There are a number of spinoffs that are involved in the computer products of our industry today as well. Digital is extremely proud to be the largest supplier of computers to NASA, in support of the space missions programs.

We're also proud here today, as one of the top ten employers in the State of Colorado.

And as Dr. Fletcher will talk later, we have people who are working on behalf of the space program providing strong support for the NASA budget and the space effort of our country in orbit.

So thank you, and enjoy your lunch, ladies and gentlemen.

**GEN. HILL:** Thank you ladies and gentlemen, for coming to this Fourth National Symposium of the United States Space Foundation, and this luncheon that is sponsored by Digital. We're very fortunate to have a company like Digital that participates with the Foundation, is willing to do things like sponsoring these luncheons, and a myriad of other things that we at the Foundation need.

It's my pleasure to introduce to you today our luncheon speaker Dr. James Fletcher. Dr. Fletcher began his career in 1940, as a research physicist with the United States Navy Bureau of Ordnance. From that point, he served in many high positions with several of the Fortune 500 companies in the private sector. In 1964, he became the eighth President of the University of Utah.

Dr. Fletcher is the first man to head the Nation's Civilian Space Agency on two occasions.

He was the fourth NASA Administrator from April 1971 to May 1977, and he became the 7th head of the agency in May of 1986.

Dr. Fletcher has been with us at past Symposia here. It's our pleasure to have Dr. Fletcher back. We are always glad to have an old friend come be with us and speak to us.

Please welcome Dr. Fletcher.

> **If leadership is to be our goal, then the nation must learn from the past in order to shape its future.**

**DR. FLETCHER:** Thank you, Gen. Hill, ladies and gentlemen, and good afternoon.

I do indeed appreciate the opportunity of addressing you once again.

It's a very distinguished group, and whatever message is given here is going to be carried far and wide, not only in this country, but abroad as well.

The last time I addressed this distinguished group was, I think, fifteen months ago, just after the Challenger tragedy, and many of you may recall that one of the major issues then, as it is today actually, was where the United States wants to be in terms of the world leadership in space in the 21st Century.

There was agreement, that if leadership is to be our goal, then the nation must learn from the past in order to shape its future.

That's been the guiding principle behind the development of both the military and the civil space programs since the Challenger tragedy, and I believe it will continue to be for the foreseeable future.

**Perhaps this is the most crucial year in the history of the United States Civil Space Program.**

Having said that, I believe it is instructive for all of us to take a brief look at how the civil space program has changed since we last met. After that, in keeping with this Symposium's theme, "Space Challenge '88," I would like to go a step further to examine the crucial issue of U.S. leadership in space.

For that's what's at stake this year. Perhaps this is the most crucial year in the history of the United States Civil Space Program.

As a nation, we have learned much about ourselves since that fateful day in January 1986 that shocked America and the whole world.

We've learned that we're a resilient people who can move forward in the face of a serious setback. We've learned not to part company with our ideals in the face of adversity. The majority of Americans continue to support their civil space program and the opportunities it presents. Most of all, we've learned, in Teddy Roosevelt's words, "Keep our eyes on the stars, and our feet on the ground." NASA too has indeed learned much from these past two years. Let me cite a few specifics.

Clearly, first and foremost, NASA has learned that it could not take its successes for granted. After 24 successful missions, we were beginning to think of shuttle operations as routine, not all of us but some of us. As a result, we had become a bit complacent. We know now that complacency has no place in space operations, manned or unmanned.

Today, NASA has corrected its technical mistakes and continues to test and retest the results. It has improved and strengthened its management structure and its internal communications as well.

**The NASA team and the American public have a more mature view of the space program.**

In fact, everything from management and staffing to the way we operate, and the actual flight program has undergone a renovation, a rebuilding, in fact, a rejuvenation.

We now have a safer vehicle and a strong and responsive management team.

The NASA team and the American public have a more mature view of the space program. In fact, a new realism pervades the program and the public's perception of it.

With this new realism have come two major shifts in public attitudes. The first is increased public awareness of the shuttle as a complex and incredibly sophisticated vehicle that must be handled with care and continuously be improved. To be sure, the shuttle has done what it was meant to do; it remains the most versatile, flexible, and useful flying machine in the world. Even so, NASA knows and believes the American people will understand that while a manned space operation may one day be routine, that day lies down the road a long way. It will not come this year or next year, but some day it will come, so long as the American people continue to support the space program, and so long as NASA continues to make excellence its hallmark.

**The second shift in public attitude is a greater appreciation across the nation that space flight is a very risky business, and that risk must be taken, if we are to reap the rewards.**

The second shift in public attitude is a greater appreciation across the nation that space flight is a very risky business, and that risk must be taken, if we are to reap the rewards.

What else have we learned from the recent past? I know the lesson is that the country never again should put all its eggs in one launch basket. Routine access to space is vital for our national security and for our scientific and technological progress. Doing everything with the shuttle is less costly in the short run, but in light of the accident, clearly more expensive in the long run. Accordingly, we are now rebuilding our expendable launch capabilities at a rapid rate. In the process, the country is fostering the growth of a private sector, expendable launch industry, a development that probably has been long overdue.

**Despite growing global competition in space, and despite the Soviets' lead in manned space flight, the United States still has what it takes to be a leader in space.**

Still another lesson can be drawn from our recent experience, and that is that we were wounded, and that wound is far from mortal. Despite growing global competition in space, and despite the Soviets' lead in manned space flight, the United States still has what it takes to be a leader in space. Because we have built on our achievements, we have a strong space program, one that I think our rivals should envy. Because we continue to push technology to the cutting edge, we have unmatched technological expertise, and the skill and know-how to make the most of future opportunities, and because we have imagination and ability to project into the future, given adequate resources, we can open up new horizons and push back boundaries that limit our goals on this planet.

America's future in space can be bright indeed, if we once again accept the challenge of leadership. Twenty-six years ago, the country accepted that challenge and achieved a goal openly, while the world watched. The meaning of the Apollo program is perhaps best expressed by the words that we left at Tranquillity Base: "Here men from the planet earth first set foot upon the moon, July 1969. We came in peace for all mankind."

With this achievement came a renewed respect for American skill, ingenuity and, perhaps, audacity. We had achieved pre-eminence in space, within a set timetable and in response to a serious challenge to our science, our technology and, in fact, our very system of government.

**These spinoffs...helped to strengthen the American economy, providing the innovations, creativity and productivity growth that sparks new industries, new products, new processes, and, of course, new jobs.**

That achievement spawned a renaissance knowledge about the earth, the solar system, and the universe. It built a technology base that produced revolutions in communications, weather, earth observations, navigation, search and rescue operations, and in the countless spinoffs that continue to benefit people everywhere. And I imagine a great deal was said about that. And these spinoffs, together with the other things that I mentioned, helped to strengthen the American economy, providing the innovations, creativity and productivity growth that sparks new industries, new products, new processes, and, of course, new jobs.

Most of all, Apollo demonstrated to ourselves and to the world, what Americans can do when we put our will and resources to work in pursuing a great national goal.

The Apollo program, of course, is history, but if we are to learn from the past, to shape our future, Apollo is a pretty good place to start. Today, there are those who would try to persuade the American people that the best is past — that from here on, it's all downhill, and that our future leadership in space is yesterday's dream and not tomorrow's reality. It's ironic that these doom-sayers have emerged this year, just when the United States is poised to launch itself into a new era of development and exploration of space.

**History has taught us that the key to economic growth and prosperity is technological progress.**

NASA's entire budget this year is 9.0 billion. That's 5 percent of a budget that is given to the Department of Health and Human Services, excluding, of course, the Social Security Commission who have a much lower percentage. It amounts to less than eight-tenths of one percent of the entire federal budget. And even with the increase proposed for fiscal '89, the NASA budget will remain below one percent of the total federal budget.

Is that too much for the most prosperous nation on earth to invest in its future? Certainly not.

History has taught us that the key to economic growth and prosperity is technological progress. In this area of competing national priorities in a tight fiscal environment, we need more, not less investment in science and technology, because these are the investments that help to create jobs and economic growth and progress in the future.

**The plain fact is that Congress must support the NASA budget as presented by the President, whole and intact, this year, because America's future leadership in space is riding on it.**

Wouldn't it be refreshing to hear a presidential candidate say just that. Yet, with all the talk about getting the country moving again, few if any have offered this, the best prescription of all. Many in Congress are supporting NASA's request for an increased budget for fiscal '89, and we are indeed grateful for that support; but we have many hurdles to overcome, as the budget wends its way through the legislative process, and as Yogi Berra said, "It ain't over till it's over."

The plain fact is that Congress must support the NASA budget as presented by the President, whole and intact, this year, because America's future leadership in space is riding on it. As I said before, that this is a make-

or-break year for the country's civil space program, and why is this?

First, this is the year that we'll restore the shuttle to safe flight with the August launch of the orbiter "Discovery." Getting the shuttle back into space and increasing its flight crew is crucial to the revival of the U.S. Civil Space Program.

Second, this is the year that President Reagan issued a new National Space Policy. The policy reaffirms our national goal of leadership in space and stresses again that the Space Station is the key to that leadership. And as you know, the policy gives the country a challenging new goal to expand the human presence and human activities beyond earth orbit into the solar system. This long-term goal will guide the objectives and directions of the civil space program well into the 21st Century. Given this goal, future decisions by the American people and their government could result in missions of human exploration, back to the moon, and/or to Mars. There is a third reason why this is a crucial year for the U.S. Civil Space Program, one that I've already mentioned earlier. This is the year that Congress will decide the fate of NASA's proposed budget for fiscal year '89.

Now, this is not an ordinary budget. It is one that is designed to enable us to do, or begin to do all of the things that I have just outlined. This budget will support the shuttle's return to space and keep it there with the gradual increase in its flight crew. This budget will further the development of the Space Station, which is the testbed for research and new technologies and systems that will get us back to the moon to establish a permanent base, and perhaps go to Mars to do the same thing. This budget will support forward leaps in space science and space technology. Such advances include the initiation of the AXAF (a great acronym for the advanced x-ray facility for major progress in astrophysics), and development of an advanced solid rocket motor to increase the shuttle's efficiency and capability to support enhanced activities aboard the base station.

**We can choose the route to leadership, or we can choose the route to the sidelines, and sit back while other nations continue to pass us by. The choice is up to us. Nobody else can make it for us.**

Just for those of you that are familiar with the space shuttle, we have lost, over the years, about 12,000 pounds in payload capability in the East/West direction coming down from the 65,000 that some of you remember was the target. The NASA rocket will get us back to the 65,000 pounds. In addition, the budget supports the new Pathfinder program to develop the advanced technologies required for future lunar or Mars voyages.

To sum things up, the nation now has a strong national policy for civil space activities, and a budget to back it up. We have the right program at the right time to restore U.S. leadership in space, just when we need it the most, when the competition is strong and getting stronger. Now, it's up to Congress to act. Given the stakes involved, I believe it is vital that Congress act wisely or the United States will end up as a follower, not a leader in space. That's why this year marks the critical turning point for the country's civil space program. We can choose the route to leadership, or we can choose the route to the sidelines, and sit back while other nations continue to pass us by. The choice is up to us. Nobody else can make it for us.

Even as the American people ponder that choice, there is another factor to be considered. The issue of increased cooperation with the Soviet Union in space was the major topic last year in your deliberations.

**The moon, as Sally Ride has suggested, might be a more appropriate initial destination than Mars for a collaborative manned mission.**

There have been calls in the Congress, and the American Planetary Science Community for the Americans and the Russians to join together to go to Mars or at least somewhere in the solar system. Last December, during the Reagan/Gorbachev summit meeting in Washington, an invitation to do just that was issued by Roald Sagdeyev, who was, I think, here last year. He was and, I think, still is, the Director of the Soviet Space Research Institute. In an article to the Washington Post, Dr. Sagdeyev wrote, "We should go to Mars together." Now, that's not an impossible dream, and I want to state here as unequivocally as I can, that we're all for working with Russians in space, because in many respects, it makes sense for us to cooperate. But if we did, the two countries should begin with unmanned programs, requiring a much shorter time scale, then looking further ahead. The moon, as Sally Ride has suggested, might be a more appropriate initial destination than Mars for a collaborative manned mission.

Before reaching specific decisions about the course to take in implementing the President's new human exploration goal, we have much planning and technology work to do. Moreover, the moon and Mars do not need to be seen as competing targets for exploration. Going to the moon together could give the two leading spacefaring nations in the world an opportunity to build a stable base for future cooperation which could one day lead to a cooperative mission to Mars.

Such a journey from its initial planning stages to its conclusion would probably encompass four or five presidential administrations. Now, anybody that's been in Washington knows what the problem is there. Therefore, it would require both domestic and international political stability for at least 16 years. That kind of stability, in both the U.S. political administrations, and in our bilateral relations with the Soviets has not yet been demonstrated.

Let us not forget, for example, and many of you were here when this went on including myself, that the Apollo-Soyuz mission, which was the first joint U.S./Soviet space project, was planned and executed within one presidential administration from 1972 to 1975.

**While we have no plans at present for joint missions, if we navigate the political waters slowly and carefully, both of us can learn how better to cooperate, independently, and perhaps, jointly.**

Another point, both we and the Soviets must demonstrate that joint cooperation can be mutually beneficial and that we can rely on each other. The old Chinese saying applies here: "A journey of a thousand miles begins with a single step." In that connection, we have begun to take many steps together, which could lay the ground-work for a strong bridge of mutual cooperation and mutual trust. As you know, beginning just about a year ago, after a lapse of several years, the U.S. and Soviets began to talk the language of cooperation. The two nations signed a new agreement to provide for cooperative ventures in planetary science, space biology and space medicine, astronomy, and astrophysics, solar-terrestrial physics and earth science. Joint working groups are exploring cooperative ventures in these areas and some others. And while we have no plans at present for joint missions, if we navigate the political waters slowly and carefully, both of us can learn how better to cooperate, independently, and perhaps, jointly. We should study each opportunity carefully to assess whether we can gain mutually by cooperating, and if so, how best to go about it. Step by step, we ought to be able to prove that scientific cooperation can work and be mutually beneficial; indeed, can benefit the entire planet. Should that happen, at that point, I believe all branches of government and the American people would then probably consider talking seriously about a joint Mars mission.

Another point, but by no means the least important, there is a question of technical readiness. It's clear that both we and the Soviets do understand that there are many technical unknowns involved in the manned Mars mission, and that this must be considered before either of us could make such a large commitment. These matters range from questions about the effects of long-term human exposure to weightlessness, all the way to the effectiveness of the closed ecological system.

Of course, in all of this discussion about cooperating with the Soviets in space, we must never forget the central importance of our cooperation with our friends and allies. This cooperation extends to building and using the Space Station, to planetary exploration and to all aspects of space science. These relationships are the heart and soul of our international efforts in space and will remain so. Meanwhile, as we continue to cooperate in space with both our friends, and our potential adversaries, competition in space poses a challenge to the United States, which after three decades has only begun this great adventure. Whether or not we continue, it's clear that others will.

To secure the United States' leadership in space and build a firm foundation for progress in the next decade and beyond, we must complete the Space Station by the mid-1990s as scheduled, and we must move ahead steadily and consistently from there, backed by a sustained national commitment of will and resources to realize that great vision of human exploration of the solar system.

**Meanwhile, as we continue to cooperate in space with both our friends, and our potential adversaries, competition in space poses a challenge to the United States, which after three decades has only begun this great adventure. Whether or not we continue, it's clear that others will.**

At this critical turning point in NASA's history, I believe that our country will prove that it has the will, it has the thrust, and it has the desire to move ahead. With your help and the support of the American people, we can begin to lay the groundwork this year for a sustained American progress in space in the years ahead.

Our success in achieving that goal will determine whether future generations will have boundless opportunities to continue what this generation has begun for the benefit of all mankind. Thank you very much.

# THE STRATEGIC DEFENSE INITIATIVE

*Moderator:* **W. Bruce Kopper, Esquire,**
Secretary-Treasurer, U.S. Space Foundation

*Keynote:*
**Dr. Gordon Smith,** Deputy Director,
Strategic Defense Initiative Organization

**MR. MACLEOD:** Ladies and gentlemen, it's with a great deal of pleasure that I introduce the moderator for the first session, the Secretary-Treasurer of the United States Space Foundation, Mr. Bruce Kopper.

**MR. KOPPER:** Thank you very much. It's my pleasure to introduce our next speaker, Dr. Gordon Smith, Deputy Director, Strategic Defense Initiative Organization.

As many of you know Gordon Smith's twenty- eight years of experience related to ballistic missiles, guided weapons and spacecraft underlie his broad perspective on, and expertise in, space and strategic defense. As Deputy Director, Strategic Defense Initiative Organization, Office of the Secretary of Defense, Dr. Smith is responsible for managing the nation's research and technology effort related to strategic missile defense. Before his appointment as Deputy Director of SDIO, Dr. Smith was President of Fairchild Space Operations Company, and corporate vice president for operations at Fairchild Industries. In 1982, he took a leave of absence from Fairchild to serve as staff member on the U.S. House of Representatives Subcommittee on Space Science and Applications. Dr. Smith also held management and engineering positions with McDonnell Douglas, DeHavilland Aircraft of Canada, and the British Aircraft Corporation. The author of numerous papers on space mechanisms, deployable structures and management, he is an adjunct professor at George Washington University. Dr. Smith is an engineering graduate of Swindon College, United Kingdom, and holds M.S. and Ph.D degrees in the Management of Science, Technology and Innovation from George Washington University. and most recently, has been nominated as the Deputy Director to the Office of the Secretary of Defense.

It's my pleasure, and will you help me welcome Dr. Gordon Smith.

**DR. SMITH:** Good afternoon distinguished guests. General Abrahamson sends his regrets for not being here today. He also sends his deputy.

What I would like to do today is to say how much I appreciate General Abrahamson's sending me, because I feel that coming to the Rocky Mountains always gives me some stability, and I always enjoy talking to the community in the Rocky Mountain regions, because I feel so much support in this area for all of our defense and space programs.

I think the committee that set up this fine conference has to be complimented.

I am also pleased to talk to you about the Strategic Defense Initiative, and particularly in the context of the Space Challenge '88, because I believe that SDI has

*DR. GORDON A. SMITH is the Deputy Director, Strategic Defense Initiative Organization, Office of the Secretary of Defense, Washington, DC. Before his appointment as Deputy Director in April 1986, Dr. Smith was president of Fairchild Space Operations Company (FSOC) of Germantown, Maryland, a division of Fairchild Industries, Inc. Prior to his appointment at FSOC, Dr. Smith was corporate vice president for operations at Fairchild Industries. During his 15 years with Fairchild, Dr. Smith held several important positions in the research, development, testing and engineering areas. During the period September 1982 to September 1983, Dr. Smith was awarded a Congressional Fellowship by the Institute of Aeronautics and Astronautics and served as a staff member on the House Subcommittee on Space Science and Applications. Prior to joining Fairchild in January 1971, Dr. Smith worked for Conductron Corporation (a subsidiary of McDonnell Douglas Astronautics Company), the DeHavilland Aircraft of Canada, Ltd., and the British Aircraft Corporation. In 1957, Dr. Smith graduated in mechanical engineering from Swindon College, U.K., and is a Chartered Engineer of the U.K., as well as a registered Professional Engineer of the State of Maryland. He holds a Master of Science degree and a doctorate in the Management of Science, Technology and Innovation from George Washington University. His doctoral dissertation examined the Department of Defense major system acquisition process.*

something to offer to our future space program, whether it be civil or military.

But first of all, I would like to talk to you about the program, bring you up to speed on where we are today on the program, and what our challenges are in the future, as I see them.

> **We set up our organization with the objective to do a research and technology program in which we would look at technologies and see if they were feasible to use in the strategic defense system; so that future decision makers could decide where to deploy, when to deploy, how to deploy, and so on.**

First of all, I must tell you that contrary to what you may read in the papers the objective of our program remains precisely the same as it was at the beginning four years ago; that is one year after the President made his speech. At that time, we set up our organization with the objective to do a research and technology program in which we would look at technologies and see if they were feasible to use in the strategic defense system; so that future decision makers could decide where to deploy, when to deploy, how to deploy, and so on.

We are pursuing that, and we are not looking at the defense of particular military assets, we are not looking at accidental launch protection systems on their own, and, therefore, we still have the original goal. It is very important to leave that message with you.

Now, in some ways, it's understandable how people can get different perspectives on what we're doing. After all, this is a dynamic program. Things are changing all the time and there have been several events over the past months that would lead one to assume that things are changing.

Let me enumerate just a few of them.

> **Coupled with early deployment talk, the advent of the ALS stimulated people thinking that we may, in fact, be going to deploy early. We are not at this time.**

The first one, 15 months ago, was talk of an early deployment. Now it must be understood, completely understood, that that did not emanate from the Strategic Defense Initiative Organization. It came from other parts of the community, some people on Capitol Hill embraced that, but, in fact, it was not an SDIO idea.

Another notion that crept into the thinking last year that something was going to happen very quickly was that we requested funding in a supplemental bill for the Advanced Launch System. At that time, we called it the heavy lift vehicle.

Now you have heard probably before in this meeting, something about ALS, the Advanced Launch System, and, in fact, we did plant the seed, and we did get some money last year. We are funding some six or so studies for the concept definition of Advanced Launch System technologies. Subsequently, the Air Force has taken the lead role and with NASA will continue with an ALS program.

It should be understood that that's for a national program and not for an SDI program, although obviously we would want to use such a lift vehicle when and if we deploy.

But nevertheless, coupled with early deployment talk, the advent of the ALS stimulated people thinking that we may, in fact, be going to deploy early. We are not at this time.

And then there was the discussion about the broad versus narrow use of the 1972 ABM treaty. If you remember, we were asked by President Reagan to say what our program would look like if he decided that we should use the broad interpretation of the treaty. Please note that it has been decided within this Reagan Administration that the broad interpretation of the treaty is, in fact, the legally correct interpretation, but policy remains that we only test within the narrow interpretation.

So what we did last year about this time was to submit to the President our idea of a re-structured program in which we could do certain testing that would be done in accordance with the broad interpretation.

What does that mean? It means that we could test systems based on other physical principles, i.e. principles not thought of in 1972. We could test them, make sure that those technologies were ABM capable, and, in other words, do some very realistic testing, and after all, that's what research is all about. You always aim to do the most realistic testing that you can possibly do under any circumstances.

We would, as a result of this, have been able to gain a higher confidence level; then when we went to decision-makers in the future, we would be able to look them in the eye and say we've tested, realistically; therefore, you can, in all justification, give the word to go ahead with full-scale development and to deploy.

As an adjunct to that particular thread of thought, we structured a program that, because we could do this more realistic testing, would actually have saved us money and would have moved the schedule to the left, instead of pushing it out to the right.

So here then last year, we had talk of early deployment, which was not ours; we had talk of the advanced launch system, which certainly was ours, but we were thinking nationally, as well as parochially for SDI, and we had the discussions of the broad versus the narrow interpretation of the treaty.

We actually are still operating under the narrow interpretation of the treaty. There has been no change in policy at all.

And then the fourth event that was particularly newsworthy last year was the fact that we were sucked in — and I use the term with all due respect — into the DOD acquisition process.

Now, the acquisition process is mandated for any major system. And it was decided that as we had made a lot of progress on our program, it was only right for us to be reviewed by a committee that normally reviews acquisition programs in major systems areas. As all of you probably know, the acquisition cycle consists of a concept definition or concept exploration phase, a demonstration and validation phase, a full-scale development phase and deployment.

**When I first joined SDI, I asked, "Will the real threat please stand up," and we had a Threat of the Week Club.**

What we did last year was go to a milestone one. We took our technologies to the committee to see which of them were ready to move into the demonstration/validation phase.

Now, several things came out of that Defense Acquisition Board review that were good. One was the definition of a threat.

When I first joined SDI, I asked, "Will the real threat please stand up," and we had a Threat of the Week Club, and I said there was no way that we could come up with an architecture if we didn't know what the threat was.

Well, as a result of this Defense Acquisition Board review, the Defense Intelligence Agency defined a threat. They predicted, in the middle of the 1990s, what the threat would be if there was a launch from the Soviet Union, how many objects we would have to engage.

And then as a result of that, the next piece in the chain was the Joint Chiefs of Staff came through with the requirements. They said, "Given that threat, we can now specify some requirements that SDIO must satisfy." What they said was that for a militarily effective defense, you have to negate a certain number of objects coming through the threat clouds onto our territory or onto the territory of our allies. So that was then a definition of the requirements.

As a result, we in SDIO were able to put together an architecture for the first phase of a Strategic Defense System. That first phase would consist of two defensive layers. The first layer would be space-based with a BSTS — that's a boost surveillance tracking system — in or about geosynchronous orbit and we would have orbiting the earth some space carrier vehicles, and each carrier vehicle would have on board a multiplicity of kinetic weapon interceptors that could go after those launchers as they come out of their silos.

Why do we want to go after them out of the silos? Because that's when we get the most leverage. Those launchers are carrying 10 to 14 bombs.

The second layer was a late midcourse layer. A late midcourse layer had ground-based interceptors that would engage in space the targets that were missed by our first phase and they would be guided by midcourse sensors.

So we had BSTS space-based interceptors, midcourse sensors, and ground-based interceptors. There was, of course, the glue that ties the whole thing together, the Battle Management/C3.

Just as a small aside, at the time of the DAB review, we had not settled on the platform for the midcourse sensor. Subsequently, we have had extensive reviews of how we should tackle that problem and we have decided that possibly we will have some space-based midcourse sensors on orbiting platforms, augmented by some ground-based platforms that are shot up on probes, have a hang time of about ten minutes, and augment the orbiting space platforms.

Now, those are very briefly the elements that went into the demonstration/validation phase. In addition, the Defense Acquisition Board said, "You shall not neglect the follow-on phases and, therefore, we want you to operate a balanced program." That is why we are funding with some vigor, as much vigor as the budget will allow, such other systems as directed energy systems, lasers, both the ground-based and space-based lasers, neutral particle beams, and also hypervelocity guns, and endoatmospheric energy weapons.

**We will build the Strategic Defense System a block at a time until we have, eventually, a very robust, thoroughly reliable defensive system.**

So, we are continuing to pursue other technologies that will actually supplement those initial elements after they're in place because what we are doing is a phased or incremental deployment. We will build the Strategic Defense System a block at a time until we have, eventually, a very robust, thoroughly reliable defensive system.

Now, to make sure that we do not forget the follow-on technologies and start pouring money into those initial kinetic energy weapons and sensors, what the Defense Acquisition Board said was that "before we allow you to go into a full-scale development of the initial phase, we want you to come back to us and tell us that the follow-on technologies are in fact feasible."

This means that until we can assure our decision-makers that we can in fact put a complete defense into place, they will not allow us to go into FSD with the first phase of elements. So that is how the Board is monitoring us, and they're visiting us on an annual basis to make sure of how the program is going. Now, what are the challenges for us as we move ahead? I think there are three main challenges. There's the intellectual challenge, the political challenge, and an affordability challenge. You notice that I haven't specifically said a technical challenge, although affordability is very much wrapped up in technical issues.

Essentially, the intellectual challenge starts off by explaining our program. Oddly enough, that is the hardest thing to do, and that is why I make no apologies to those people in this room who have heard me say this before and describe the program as I have just described it. Because if you read the papers, the papers will only show part of the story and, therefore, we have to explain our program. We have to explain it to the public and particularly to the politicians who are looking after our budget. That is part of the intellectual challenge.

**I think there are three main challenges. There's the intellectual challenge, the political challenge, and an affordability challenge.**

But, of course, a bigger issue is how do we transition from an offense to a defensive type of strategy without upsetting the delicate balance and the stability of the world as it now is? In fact, what we want to do is to make the world more stable, we want to add to deterrence. So that means when we start to put something into place, we have to be very sure that we're doing the right thing.

In regard to that, we have also to consider suggestions that come in from outside of the program and I would like to say to you, any of you who have ideas, we're still very much open to them. We have not closed our minds because the Defense Acquisition Board has said, "These are the specific things you shall do now in the demonstration/validation phase."

As a result of this type of thinking, Senator Nunn brought forward his accidental launch protection system idea. We are taking a good hard look at that idea and we will present what we think could be done about that at the next Defense Acquisition Board review.

In the meantime, it makes good sense to consider the notion that the ALPS proposal could be an incremental step toward our Phase I as we currently are setting it out. As a matter of fact, if we had Phase I in place right now, that would automatically take care of the accidental launch concern of Senator Nunn.

With regard to the next general category of challenge, the political challenge, mainly, of course, we are concerned with constrained budgets. But be that as it may, we are still getting some increases in our program, and as any of you who followed the program over the last few years know, we have had steady increases, although we've had nowhere near what we have been asking for.

This year we have $3.6 billion and we are asking for $4.5 in fiscal '89. At the moment, the House has acted and has marked at $3.74 billion. The Senate has not yet acted, and after that, they will go to conference. I am hopeful that we will get well in excess of $3.74 billion; in fact, I'm hopeful that we will get close to our $4.5 because we definitely need a minimum of $4.5 to keep this program going as we restructured it.

**Very fortunately for us, we have, of course, a President who is absolutely 100 percent behind us and does not intend to bargain us away.**

The other problem that I have in the political arena is the ever-nagging concern about micromanagement from Capitol Hill. Let me tell you what I mean about that.

Of our $3.6 billion they said, "Well, let's put a minimum of $150 million to the advanced launch system; let's put another couple of hundred million dollars to the boost surveillance and tracking system; let's put 17 million to the medical free electron laser"; in other words, they're saying, "Here's the money. Now you must do with it as you see fit."

So this is where we are with our program and the political issues. Very fortunately for us, we have, of course, a President who is absolutely 100 percent behind us and does not intend to bargain us away. As a matter of fact, on the 14th of March, the President addressed a conference of engineers and scientists in Washington, D.C. He said, to them, "You people are not working late into the night just to construct a bargaining chip." So here we have a very vigorous backing from our President, and not only backing but leadership as well.

And going forward, I really think that SDI will continue, and the reason I say that is because we have had increasing budgets and we do have support from both sides of the aisle. We don't get enough money but we do have support. We have support on the one hand for vigorous research and we have support on the other hand for deployment. If they can ever get together, we will have a good program.

So what I think we will have going forward into the next administration is still a lot of support from The Hill, and I don't think the SDI program will disappear into the woodwork.

In brief, we have the intellectual problem, we have the political problem, and then, of course, we have our affordability problem. It's not a problem so much as a challenge. Considering affordability, we were asked how much it would cost to deploy the first phase of a Strategic Defense. Not to maintain it, not to do the research, but just to deploy it, and we said it would cost between $75 and $150 billion.

Now, why is there that spread of money? The spread of money comes from a couple of points, really: One is the uncertainty that still remains in the final fine-tuning of any architecture we deploy; but, secondly, it comes from two ways of trying to do business: One is the "business as usual" way and the other depends on innovative approaches to producibility that we are pursuing in our program. If you go to the aerospace industries now and say, "Cost me out a new satellite to do the following things," they will go to their books and they will give you the schoolbook answer of how much it will cost.

And this is what Norm Augustine was getting at in his book when he wrote that "if the trends continue into the future as they are today, by the year 2054 this country will be able to afford only one aircraft and that aircraft will have to be shared, with the Navy flying it three and a half days a week and the Air Force flying it the other three and a half days. On the one extra day in Leap Year the Marines get to fly the thing."

**We are looking at various other things to try and reduce costs, but the most important thing we've got to do is to get people to think differently.**

So this is what we've got to do. We've got to turn around our thinking of how we do business, and that's why we get such a broad spread of estimates when we talk about affordability.

In SDIO we are doing a lot to try and do things differently and we are setting up pilot production lines to look into the manufacturing of the chips that may be needed. We are looking at roadmaps where we can use the same devices in different types of interceptors, the same inertial measurement units in both our ground-based and our space-based interceptors, for an example; therefore, we would get the economy of scale. We are looking at various other things to try and reduce costs, but the most important thing we've got to do is to get people to think differently.

I suggest a couple of things: One is start with a clean sheet of paper because all the old ideas need revising; and, secondly, we ought to keep our appetite more in tune with what we really require. And by that, I mean wouldn't it be nice to keep our requirements within our capabilities. For example, it would be great if we had the capability of launching 200,000 pounds but we only needed to launch 150,000 pounds.

Here we are, then, with our challenges going forward. I think that the intellectual challenge, the political challenge, and the affordability challenge together represent something to keep us all occupied in the next few years, and I think we will be occupied because we've got a very virile program.

I think that what we have now is a program that is well constructed and going very nicely. A couple of years ago we had a shopping cart full of groceries. Now we are creating the dinner from these groceries. We've gone through the soup and the fish courses and now we are beginning on to the main course, and the dessert will follow.

**When we use our affordable space launchers to launch our affordable spacecraft to reach for the stars, we want to know that those people who go out in those vehicles have a secure world to come back to, and I think that's where we are with SDI.**

I think we have some direction in this program and we can forge ahead. And I believe the contributions that we are making, say, to this conference and to the steps ahead in space and to the leadership that Dr. Fletcher talked about at lunch are twofold: One is affordability. We must have affordable things to get up into space to do all the wonderful scientific things that you out there want to do. Also, we want a secure world, and when we use our affordable space launchers to launch our affordable spacecraft to reach for the stars, we want to know that those people who go out in those vehicles have a secure world to come back to, and I think that's where we are with SDI.

Thank you very much.

**MR. MACLEOD:** The first question would be, if you get the go-ahead and adequate funding to deploy the first phase of SDI, how long would it take and what would the first-phase requirements be?

**DR. SMITH:** We have been planning, depending on the budget, that the full-scale development phase may take about four years, and what we've been saying is that we want a decision-maker to make a decision in the early '90s.

Because of our budget this year and the planned budgets in the next five years, it is fair to say that the program decision point has slipped a couple of years to the 1993-1994 time frame. A full-scale development would take approximately four years beyond that before we could start to deploy.

What are the requirements? Well, the requirements are laid down by the Joint Chiefs of Staff and I cannot discuss them in detail.

**MR. MACLEOD:** Technically, isn't it possible that a space-based system capable of destroying missiles in the boost phase would be just as able to destroy ground targets, that is, able to be used as an offensive weapons system? Is this not destabilizing rather than stabilizing?

**DR. SMITH:** I think the fallacy there is assuming that we would go to the expense of designing a space-based weapon that would survive a re-entry and be able to penetrate down through the atmosphere to a ground target.

We already have our ICBMs that are capable of hitting targets in the Soviet Union and, therefore, it would be too costly for us to design kinetic energy weapons or any other weapon, for that matter, to target those targets from space. It just would not be sensible to do and we have no intention of doing it.

**MR. MACLEOD:** Isn't all this narrow versus broad interpretation of the ABM treaty a lot of distracting nonsense?

Why aren't you structuring your tests to be the most realistic and effective they can be, especially since the administration believes in the broad view anyway.

**DR. SMITH:** Thank you for that question.

I don't think SDIO decided that we would engage in the broad and narrow interpretation. It has been a distraction to us, there's no doubt about that.

Secretary Carlucci was very interested in how our program could be given the best programmatic and technical approach to that program.

And, in fact, we did restructure our program and the funding for all of the technologies. We did restructure in accordance with the Angier funding and we did submit our revised program to the Congress this April in our annual report to Congress. It does lay out tests, and they're classified tests. Most of them, as a matter of fact, do already, we know, comply with the narrow or strict interpretation of the treaty.

There are some questions with some of those experiments that we intend to do, and by "questions," I mean they will go to the compliance committee and be reviewed by that committee and decisions will be made downstream of today to decide whether we should restructure those experiments to keep them in the restrictive interpretation or whether to go ahead with them as they are presently structured. So we have in fact endeavored to put together a realistic program.

But, as a matter of fact, I should stress that none of our experiments this year or next year, in accordance with congressional mandate, will be carried out under the broad interpretation, none.

**MR. MACLEOD:** Wouldn't you prefer to apply the same R & D resources in cooperative space-based ventures with the USSR, an available option, instead of providing our children with a space frontier full of weapons and debris?

**DR. SMITH:** I suppose the hypothetical question at this time is, wouldn't it be great to have cooperation with the Soviet Union. As a matter of fact, that has always been in President Reagan's mind, and we would hope eventually that we could, all of us, go to no offensive weapons at all and have very, very small amounts of defensive weapons, to guard against third countries, let's say.

So the goal really is not to have an awful lot of weapons anywhere, and if we can come to some agreements with the Soviets, so well and good.

**MR. MACLEOD:** Couldn't accidental launches be handled by ground techniques? And, if so, wouldn't that be cheaper?

**DR. SMITH:** We are studying that problem right now. And by "accidental launches," I think a lot of people have overreacted to this and are expecting instant answers.

First of all, you have to define what is an accidental launch. Is it a single ICBM coming from a rogue country? Is it a boatload of weapons fired off by a demented captain of a boat? What is the threat?

It gets back to what I was saying just now. If we knew what that threat was, then we could state some requirements, then we could state an architecture, then we could cost out an architecture.

I think at this time to say that it can be done ground-based less expensively than space-based is too soon to say. We're exploring it but we're doing it in a very logical fashion.

**MR. MACLEOD:** Has the BM/C3 aspect coalesced into a suitable program? And, if so, what is it?

**DR. SMITH:** Again, that's a very good question.

The glue that sticks it all together has to go forward with those elements that make up the architecture. As a matter of fact, a lot of the battle management, communication, control, and command are embedded in the elements themselves. So, therefore, they are being designed into those elements.

There are various experimental versions of simulations of battle management that we are working on. One is working on a space-based simulation of an experimental version of a defense that is being headed up by the Air Force.

The Army is heading up a ground-based experimental version.

We are, as you know, working on the national test bed just down the road here at Falcon Airfield, and there we have another local company, Martin Marietta, heading up that simulation activity that will hopefully be able to give us more of an insight into how our program will eventually work.

**MR. MACLEOD:** Please summarize the extent of the breakthroughs of a technical type of the program during the past year.

**DR. SMITH:** I consider "breakthroughs" an overused word. We've made a lot of progress on a lot of fronts.

I will give you just one very good bit of progress that we did make because I think it's important to know that we are very worried about the discrimination in the mid-course.

The recent test in the January-February time frame: we launched a Delta from the Cape and on that Delta there was a space vehicle. The space vehicle had seven sensors onboard. Three of them were active sensors and four of them were passive sensors, and we were able to characterize plumes, we were able to characterize objects that were thrown out of the spacecraft as it orbited the earth, and we were able to look at the backgrounds, the earth's limb; space background, earth background, and characterize all these things, and we did it very successfully in a variety of spectrum bands. We feel that as a result of that test, we now have a better understanding of what happens in space with different objects and we will be better able to design sensors capable of making discriminations.

**MR. MACLEOD:** Please comment further on why SDIO is not promoting early deployment. Don't we need protection from a first strike? Are you attempting to pacify the politicians?

**DR. SMITH:** We don't pacify anyone. What we do is we discuss with people and hear their views and try to incorporate their views so that, collectively, we can do the right thing.

Yes, there is a concern about an accidental launch. It's here now today.

There's concern, of course, about more than an accidental launch, but our policy has been that we are not advocating an early deployment before we understand the totality of what we want to do, and I think that comes back to what I said previously: one of the things we have to offer is our systems or global view of the world. I think it probably is a little premature to rush into deploying something that may not fit into the overall scheme of things, the overall architecture. However, that's a political question.

If someone wanted us to do something like that, they could tell us to do it and we could do it. But how effective it would be and what we would defend against at this point in time I don't know.

**MR. MACLEOD:** What role does the project Centauras nuclear reactor-driven laser play in your development strategy? And can you describe any test progress?

**DR. SMITH:** I'm not in a position to describe any test progress in that regard, but I will say that there is a research program. It is being funded — not at the very high level, I might add — and the Department of Energy is involved and so, of course, is the Strategic Defense Initiative Organization.

It does not figure in any of our architectures at the moment. We are not including an X-ray laser in our architectures. In other words, we are looking at it from a research point of view. We want to understand the technicalities and the science of that particular device and, therefore, we are doing the proper research at the proper level and we are not including it in any architectures.

**MR. MAC LEOD:** Is the Phase III part of the Zenith Star program possible under the strict or narrow interpretation of the ABM treaty?

**DR. SMITH:** Our compliance people are currently looking at the Zenith Star program. The Zenith Star program, incidentally, is a program where we will use a space-based laser, a chemical laser, with a large aperture mirror, and we will do, hopefully, some elementary tracking and pointing with that space platform.

We have been, over the last several months, trying to generate a sensible experiment. We think that we may have the glimmers of hope here of having a sensible experiment. It is being reviewed by the compliance committee to see if it is in the narrow or the broad. We believe that we may be even able to get some useful information from a narrow- interpretation experiment.

**MR. MAC LEOD:** Assume that the Strategic Defense System is eventually deployed. Will the doctrine of Mutual Assured Destruction (MAD) be laid completely to rest? And what role will remain for our strategic offensive forces?

**DR. SMITH:** Well, the MAD doctrine, I hope, is not here to stay. I can see a transition to a defensive strategy incorporating both offensive and defensive weapons. In other words, if we had a Start treaty that drew down 50 percent of our offensive weapons, we still would be very much at risk. 50 percent doesn't do an awful lot for us from a protection view, it's more a psychological point of view.

So what I can see is that we would be potentially putting in some defensive elements at the same time as we're drawing down. Now, whether eventually the MAD philosophy will completely go away, I hope it does.

**MR. MACLEOD:** Would you give us some examples of how the cost of SDI has been exaggerated, for example, by the Union of Concerned Scientists, Dr. Harold Brown, and so forth.

**DR. SMITH:** I don't understand the question. I don't know where anyone gets their costs from to be quite frank with you, and, therefore, I'm not trying to be facetious, I just don't understand it. I know that everyone has their own idea of what a defensive system should comprise, but what that defensive system is that they go out and cost and then put into the papers, I don't know what that is and, therefore, I can't comment on it.

**MR. MACLEOD:** How much support is SDI getting from Europe? The system helps them as much as the USA, doesn't it?

**DR. SMITH:** Yes, it does and, as a matter of fact, we are getting a considerable amount of support from our allies. We have a memoranda of understanding now with five different countries: The U.K., Germany, Italy, Israel, and Japan, and all of them, with the exception of Japan, which has just come on board, are contributing quite well.

They do not get quite the funding levels that they would like. Their expectations are a little higher than we have been able to actually implement at this time. However, they do have a lot of good technologies.

You've got to understand that we don't give money away. We don't have any set-asides, and we have them compete for everything that they get.

They're working now on about a level of $135 million. That's not a lot of dollars, and that's been over the past two years and some of those are for ongoing contracts. So we have only placed about $135 million of SDI money abroad. But what we are getting for it is very good. The technologies that are coming to us are good, an ion source from the U.K., free-flying space platform from

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MBB in Germany. The Israelis are about to embark upon a surface to air weapons system that could be used as a tactical defense. So we're getting a lot of good thinking, plus we are getting a lot of thinking about how to structure an architecture for a theater defense. After all, they have a lot of understanding of theater and they have been working on theater studies and we've got a lot of good ideas. They really are contributing.

**MR. MAC LEOD:** This is an interesting one. Suppose the "dinner" you have cooked was made up of old food and we could all get very sick from it. Would you serve it anyway, or would you admit that it was old and cook another without space-based weapons if it would be a better dinner? Besides, don't you care about space junk food?

**DR. SMITH:** That's a good one, isn't it?

Well, first of all, I am absolutely opposed to junk in space, and I would think, too, that we are professional enough to only do what we think is the right thing. Now, we have so much help in deciding what is the right thing, that I am sure that when the chips are finally down, everyone in this democratic society of ours will have had an opportunity to say whether it's junk or not. I don't think, as responsible citizens, that we are ever likely to do anything junky.

**MR. MAC LEOD:** And a final question, how could a decision-maker be convinced to field the system when the total system cannot realistically be tested?

**DR. SMITH:** Well, I don't think we have totally tested our ICBM force as an offensive force.

Pity that was the last question.

**MR. MAC LEOD:** Would you have a closing comment of any kind?

**DR. SMITH:** I have enjoyed it. Thank you.

**MR. MAC LEOD:** Thank you very much.

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# PANEL: SDI - MYTH OR REALITY?

*Moderator:*
**Dick MacLeod** Executive Director, U.S. Space Foundation
*Speakers:*
**Lt. General Daniel O. Graham,** USA (Ret.)
Director, High Frontier Foundation
**Dr. Greg Canavan,** Assistant Physics
Lab Leader, Los Alamos National Lab
**Dr. Satish Dhawan,** Director, Institute
of Science, India, representing the World Peace
Council, Helsinki, Finland
**Mr. John Pike,** President, Federation of American
Scientists

*LT. GENERAL DANIEL O. GRAHAM, USA (Ret.) was born in Medford Oregon, where he attended public schools, and then graduated from the U.S. Military Academy at West Point. During his military career, General Graham served in Germany, Korea and Vietnam. His assignments included analyst of Soviet and East European affairs in the office of the Assistant Chief of Staff of the Army, serving on the staff of the Office of National Estimates of the Central Intelligence Agency, Chief of Current Intelligence and Estimates for the Military Assistance Command in Vietnam, Director of Collections and Director of Estimates at the Defense Intelligence Agency, Deputy to the Director of the Central Intelligence Agency and Director of the Defense Intelligence Agency. After his retirement from military service in 1976, General Graham became a Research Professor at the University of Miami. He also served as an advisor to President Reagan during his 1976 and 1980 campaigns. In 1978, General Graham left the University to become Co-Chairman of the Coalition for Peace Through Strength and a Staff member of the American Security Council. In 1981 General Graham founded and became Director of High Frontier.*

**MR. MACLEOD**: Our next approach, having heard from the SDI office as to what it is they're doing and their thoughts on current procedures, and status of the program, is to take on a pro and con panel. The subject: "SDI - Myth or Reality?"

We have assembled for that four eminent gentlemen to consider both the pro and con sides: Lieutenant General Daniel Graham, Director of the High Frontier Foundation, will be speaking first, followed by Dr. Greg Canavan, Assistant Physics Division Leader at Los Alamos National Laboratory; and then Dr. Satish Dhawan, just retired as Director of the Institute of Science of India representing the World Peace Council of Helsinki, Finland. And, finally, Mr. John Pike, who is Associate Director for Space Policy of the Federation of American Scientists. Mr. Pike has to make a departure at about 4 o'clock, so we are going to ask each speaker to speak for approximately 12 to 15 minutes and then we will spend the rest of the time taking Q & A.

General Daniel Graham, following a long and illustrious career in the United States Army, is credited with one of the first suggestions for a ballistic missile defense and the suggestion, perhaps urging, of a Presidential candidate to go from a MAD doctrine to a defensive doctrine. He is currently still directing the High Frontier Foundation and a strenuous effort to convince the American people that his initial proposal and those that have followed are the best way to go. Let's hear from General Graham as to what he believes we should be doing at the current time.

**GENERAL GRAHAM**: I was really delighted to hear Dr. Fletcher and Dr. Smith. I'm glad I got here in time to do it, because I certainly agree that this year is very critical for space efforts and for the largest space program that is being seriously considered by this country, which is SDI.

I want to speak a little bit about where we stand and what the problems seem to be. First of all, the chances of moving ahead both in space and SDI this year seem to hinge on three different types of players: One are the purely political ones, another the ideological players, another the bureaucrats, and one very strong player outside the country, that is, the Soviet Union. Let me speak first about the Soviets.

I was in the Soviet Union last June. To my astonishment they were rather insistent that I come over and tell them what I thought would happen in space militarily in the 1990s, and I couldn't figure out why.

**This year is very critical for space efforts and for the largest space program that is being seriously considered by this country, which is SDI.**

Apparently they don't believe that anybody can be as adamant about it as I am and they wanted to check it out personally.

But I was happy to talk to the Soviets because I find them the best witnesses in the world that we are doing the right thing.

I tend to agree with that great test pilot, Chuck Yeager, when asked, "Can we do SDI?" and he said, "Hell, yes, we can do it, and anything that runs the Russians that far up the wall we sure ought to do."

**But I was happy to talk to the Soviets because I find them the best witnesses in the world that we are doing the right thing.**

Well, it is running them up the wall and we need to understand why. First of all, the Soviets know perfectly well, whether we do or not, that for the $75 to $150 billion that Gordon Smith was talking about, we can deploy a defense which already negates the real value of a trillion dollars Soviet investment in long-range, first-strike ballistic missiles. It negates — it doesn't make them go away. You can still kill people with them, just as you can still kill people with crossbows, but a large mass of men armed with crossbows is not very efficient anymore because the men carrying them would be too ineffective and the men themselves too vulnerable, and the same thing will be true of their long-range ballistic missile force, and they know it.

**We can deploy a defense which already negates the real value of a trillion dollars Soviet investment in long-range, first-strike ballistic missiles.**

So in military terms, of course the Soviets do not want the United States to field a defensive force and, particularly, they do not want it in space because the Soviets understand, whether we understand it or not, that space is the new high seas, that somebody is going to control it, and if it falls to the control of the Soviet Union, it is not going to make too much difference how many ships, planes, tanks, army divisions, we've got on the ground. They know that.

However, again, to echo what Gordon said, the Soviets fear of SDI and their frenetic attempts to get rid of it, which has included assassination of scientists in Europe, their frenetic attempts to stop it are not simply due to the fact that they will be losing a military advantage, but because SDI strikes at the heart of the whole Marxist/Leninist totalitarian system. We need to understand this.

**The Soviets understand, whether we understand it or not, that space is the new high seas, that somebody is going to control it, and if it falls to the control of the Soviet Union, it is not going to make too much difference how many ships, planes, tanks, army divisions, we've got on the ground.**

The Soviet Union is having trouble now coping with the post-nuclear technological revolution that centered around the computer, especially the computer since microchips. The Soviet Union is not merely facing the problem of how to build factories that can produce computers, they are facing a fundamental problem in their entire system. What is making technology roll forward fast now, and causes Jim Abrahamson to poke his finger in the eye of the "can't be done" crowd every few weeks with another technological advance, is the fact that so many technical people have a personal computer, a printer, and access to real data, sitting on their desk. They have all that assistance and technical power. And the Soviets know that if we go SDI we're going to exacerbate a problem that is already hurting them, which is a surge of new technology, which will put the U.S. and western technology on such a high plain that the rascals can't steal technology fast enough to keep up.

If they try to keep up, they will have to give a million or so technicians personal computers, printers, and access to real data, and you know what will happen then? One of the great pillars of the Soviet system, centralized control of all information, will collapse, and with it, the Soviet system. Now, don't think for a minute that Gorbachev doesn't know this.

On July the 19th, Gorbachev was speaking to Rajit Ghandi of India, who was on his way back to India, and he said something that was reported in our press but the press people didn't know what to do with it. Gorbachev said, "In arms control, I have offered the Americans to go to zero nuclear weapons." He hadn't actually done that but this is what he said to Ghandi. Secondly, he said, "I have offered to cut back sharply in conventional weapons, but the Americans are holding out to force the restructuring of the Soviet socioeconomic system." I don't know how this story was handled in your home town, but in Washington these great pundits looked at it and said, "Well, Reagan's a son of a bitch, to be sure, but he didn't say you have to restructure your system." But to Gorbachev he had, because Reagan was still holding out for SDI and he wasn't going to stop the surge of technology that is going to force the Soviet Union to reform its whole system.

**The Soviets try to keep up, they will have to give a million or so technicians personal computers, printers, and access to real data, and you know what will happen then? One of the great pillars of the Soviet system, centralized control of all information, will collapse, and with it, the Soviet system. Now, don't think for a minute that Gorbachev doesn't know this.**

So there you have the reason for Soviet dread of SDI. I understand the Soviet position perfectly. If I were trying to maintain my power in the Soviet union, I would do everything I could possibly do to stop SDI, including giving up half of my offensive missiles. If it were necessary to stop SDI I would do it, because I would know, as a Soviet marshal, that I'm far better off with half the number of ballistic missiles I have and the dumb Americans still not defending themselves than with four times the number of missiles I've got and the Americans having a defense - any reasonably effective defense. So the Soviets are going to try to stop it.

Now, understanding the Russians is one thing; understanding the people on our side who don't like it, that's where my problem comes. Of course, part of it is just simple politics. This idea came from a conservative Republican, and if you are a liberal Democrat you are supposed to be against it. To those of you who are conservative who would like to snicker about that, I guarantee you that if George McGovern had come up with this idea, there would be conservatives saying, "There's got to be something wrong with it." That's just normal American stupid politics.

Now, as of today, you had a whole bunch of people who ran for President on the democratic side. I've lost count there were so many. But I do know this, that every one of them is dead set against SDI. And Dukakis the other day, feeling that Jesse Jackson may be stealing the show from him on being against SDI, changed from being, "I would curtail SDI," to, "I would cancel it."

So one of the litmus tests that anybody had to pass this year to become a candidate for the Democratic nomination was, you must be against SDI. Why? because SDI killed our nuclear freeze movement and we want to get that going again. So you've got to be against SDI.

Well, Sam Nunn thought he might want to run for President. Sam looked to the right of him in the Democratic party, there was nobody there. So Sam said, "I've got to do something to appease — how do I appease you guys over there on the left side?"

They said, "You've got to do something about that terrible voting record you've got on SDI because you have been voting for top dollar on SDI every time it comes up." And Sam had.

**President Reagan and his advisors made a terrible mistake when they tried to create a broad interpretation of the ABM treaty. They should have said, "Look, the Russians have violated it. We have made the case. To hell with the ABM treaty, we're going to defend ourselves."**

Furthermore, Sam had been saying all along privately: "Unless the President will come in with a deployment, we are going to have trouble holding the research money at the levels that he wants."

So what did Sam do? Sam tried to turn it into a lawyer's paradise that you heard discussed a minute ago, broad versus narrow interpretation of the ABM treaty. This is ridiculous. There's absolutely no compatibility between SDI and the ABM treaty. The ABM treaty was drafted, negotiated, and ratified by the United States Senate on two premises: one, you cannot defend against these weapons; and, two, you should not defend because it weakens the mutual assured destruction strategy. SDI says: "We can do it and we should."

Now, how in the world are you going to be for the ABM treaty and for SDI? You cannot, and I think that President Reagan and his advisors made a terrible mistake when they tried to create a broad interpretation of the ABM treaty. They should have said, "Look, the Russians have violated it. We have made the case. To hell with the ABM treaty, we're going to defend ourselves."

Now, we've got essentially one other group of opponents - the ideologues. I want to talk to something they have done recently. These days, opposing the idea of SDI has become a pretty pathetic exercise for the people on the anti-side Some of them have told us for many, many years how they hate and despise nuclear weapons, how they loathe the bloody things. Now they suddenly find themselves in a love affair with nuclear weapons. They say, "Oh, look, we don't want these defenses. We believe in negotiations with the Soviet Union. But we have to admit that until that fine day when all nuclear weapons disappear, we want to rely on the vengeance of mutual assured destruction. We do not want to interfere with the lethality of the Soviet weapons system."

Now, in one debate I had with a very bright woman, who was a professor, who had her facts and figures pretty well in hand, but got very frustrated and said, "The trouble with General Graham is that he doesn't understand that in the interest of stability, we must allow Soviet missiles a free ride to their targets."

Now, that was the University of Iowa, not actually my kind of people usually, but they were my people that night. Students looked at each other and the faculty who brought the lady in, jaws dropped, and all I had to do was cross my arms and smile smugly from there on in.

And now Senator Sam Nunn, having found that he couldn't capture left-wing people, has said, "Well, I think we ought to deploy something, at least so that we can protect ourselves against accidental attack." To me, this is a very good sign. I know it kind of messes up the planning in the SDIO shop, but as I have told them, and I told the President day before yesterday, "Treat it this way, sir, Sam Nunn is a little bit pregnant," and he is.

The next question to ask Sam is: "Sam, okay, where is the accident going to take place? Is it going to be Miami or Seattle or Atlanta, Georgia? Where are we going to have our accident?" Well, we don't know. So we had better protect everything.

**So, you see, even in the political sense, opposition to SDI is beginning to break down.**

"How about our allies, are they entitled to be protected against accidents, too?" After all, the Saudis just got 1300-nautical-mile missiles and Khadafi's buying some from the Brazilians. The Syrians have already got some. Khadafi has already fired at NATO, at least at Italy.

"So, Sam, where do we defend? Do you want to defend against accidents? I tell you, Sam, the best way to do that is get into space with a global defense that will take care of any missile fired from anyplace at anything. Now we are taking care of defense; now we are taking care of your problem of accidental or rogue nation attack."

So Sam is a little bit pregnant, I think, and I told the President day before yesterday, "Take him up on it. Just don't tell him this is as far as we're going to go, but take him up on it," and I hope he will.

So, you see, even in the political sense, opposition to SDI is beginning to break down.

And in the ideological sense there's one more thing that I want to talk about. That is the most ridiculous book that I have seen in ages. It came out in the **New York Times Press**, written by Bill Broad, the science editor of the "New York Times", plus Leslie Gelb and a few others. You should read it, not because there's any information in it. It's packed full of gross inaccuracies that I can document as inaccuracies, but it is kind of interesting.

The first chapter says Ronald Reagan really made this decision to go SDI because in 1940, he played an agent in a movie called "Murder in the Sky" where some wicked scientist had come up with a machine that stopped the motors of airplanes so that they would fall out the air. Reagan had to track them down as Detective So-and-So, and because of that movie, Reagan went SDI. If there was another reason, it was because a certain Dr. Strangelove, alias Dr. Teller, was feeding him all sorts of bad information. This is Chapter I.

Now, it gets better. Chapter II is a gothic novel - a Sci Fi story a wicked combine is stealing children because they're brilliant, they're scientifically brilliant, and these wicked people put these children to work on scientific matters that they want for their own evil purposes. Once they have trained this child to work on that, then they lobotomize all the rest of the child's brain so he can only work on the one thing. Then they move that to Livermore Labs and an outfit called the Hertz Foundation, which is the wicked organization, steals a fellow named Peter Haglestein. Lowell Wood, who is here with us, and Dr. Teller sit down and lie to him and tell him, "Lookit, what you are going to be working on is all peace, no weapons, you see." Then they get him in there and they more or less lobotomize him and the poor kid is working on X-ray lasers. And there's a young woman, just as in most gothic novels, a fair young damsel out there who sticks by the truth, the Peace Movement. She is praying and doing everything she can to get young Peter out of this mess that he's in with these evil scientists.

**Many of us still believe we ought to do something on the grounds that America is more interested in live Americans than dead Russians and that we deserve to defend the place.**

Finally he gets out and the end of the story is, hurray, he's out. The hero is a real fellow who worked out at Livermore Labs, worked on the X-ray laser, was a colleague of Lowell Wood's, and so forth. Nowhere does he say, "Boy, did I have qualms of conscience about working on X-ray lasers." Never. All this non-science was written by William Broad, science editor of the "New York Times" - not the drama critic, the science editor. Broad's last input, Chapter 12, is "The Threat to Science by SDI." SDI, by pouring billions of dollars into scientific laboratories, is threatening science. But people who come up with cockamamie ideas like Nuclear Winter are not threatening science.

Well, I recommend that you read that book because if you've got your perspectives right, you will find it is more amusing than alarming. Many of us still believe we ought to do something on the grounds that America is more interested in live Americans than dead Russians and that we deserve to defend the place. We ought to get space really moving by adopting that one space program that keeps a constant three-to-one advantage in the public mind.

Thank you very much. I think that's about as much time as I've got.

**MR. MACLEOD**: Well, we have been talking about perspectives and you get a different one right there. We will have another one now from Dr. Greg Canavan, who is the Assistant physics Division Leader at Los Alamos.

Dr. Canavan was the Director of the Office of Inertial Fusion in the Department of Energy from 1979 to '81 when he reported to the Assistant Secretary for Defense-Programs. He was responsible for research, development, demonstration and utilization of laser, electron, and ion beam fusion. He was a White House Fellow, assigned in 1977 - '78 to the DOE and served as Special Assistant to the Secretary of DOE. He served as Program Manager for advanced laser research for the Defense Advanced Research Products Agency (DARPA) from '75 to '77, and he was the laser nuclear weapons and weapons effects research responsible individual at the Air Force Weapons Laboratory, January '69 to '74.

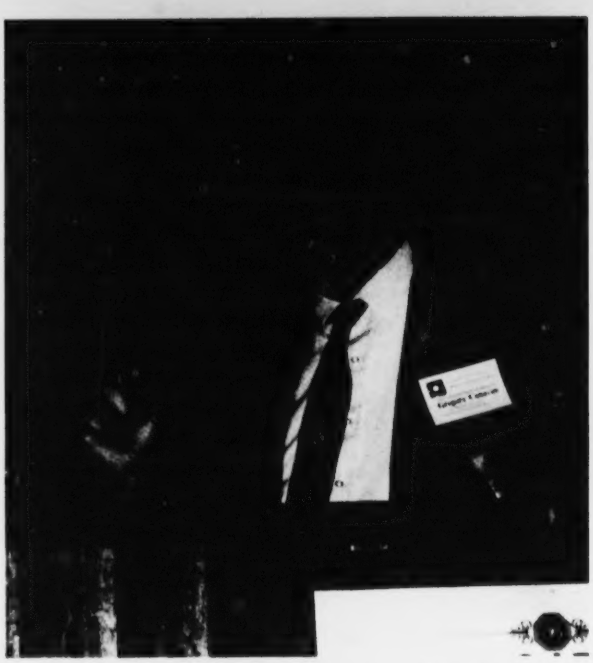
He graduated from the U.S. Air Force Academy with a B.S. in mathematics in 1975. He attended graduate school at the University of California at Davis in Livermore and received an M.S. and Ph.D. in applied science in '67 and '69. To complete his education, at Auburn University he received an MBA in energy economics.

Dr. Canavan has broad experience in dealing with the subject, has engaged in debate before, and has consented to come today to argue yet another aspect, another perspective, of the SDI issue.

**DR. CANAVAN**: The title of this talk suggests that myth and reality are antithetical, but they are actually complementary. Myth is the means by which preliterate folk combined the things they understood about nature with unexplained observations of rain, fire, and other phenomena to produce a coherent picture of the world around them. As more things became understood, the need for myth receded, ultimately leaving the structure we call scientific knowledge.

That process of working from myth toward reality still goes on today in fundamental areas such astronomy and cosmology, which are still a blend of myth and science. It also goes on in applied studies such as strategic defense. This note gives a brief review of previous strategic defense concept's steps from myth toward science. It reviews earlier concepts' weaknesses, the extent to which they can be overcome by current technologies, and their probable performance against evolving threats.

That "past is prologue" is particularly true in the area of strategic defense, which has seen a number of antiballistic missile (ABM) concepts in recent decades. Those of the 1950-70s were based on nuclear-armed Nike interceptors guided by large phased-array microwave radars. Over two decades, these early ABM concepts passed through three stages — intended for limited, population, and missile defenses — which reflected the growth and decay of expectations for the performance of concepts based on those technologies. The interceptors and warheads worked well; the radars didn't. The long range radars could be blacked out by high altitude bursts, which made it possible for the attacker to exhaust the shorter range radars as well.



*DR. GREGORY H. CANAVAN is currently the Assistant Physics Division Leader at the Los Alamos National Laboratory, and Technical Advisor to the Associate Director for Defense Research Programs. Until 1983 he served as the Associate Physics Division Leader for Advanced Concepts. Dr. Canavan was the Director, Office of Inertial Fusion, Department of Energy (DOE) Washington, 1979-1981. Dr. Canavan served as Deputy Chief, Staff Group to the Chief of Staff, U.S. Air Force, at the Pentagon, 1978-1979 retiring as a Colonel. He was a White House Fellow (1977-78) assigned to the DOE and served as Special Assistant to the Secretary, DOE. He served as Program Manager for Advanced Laser Research at the Defense Advanced Research Projects Agency (DARPA) from July 1975 until August 1977. He performed laser, nuclear weapons, and weapons effects research at the Air Force Weapons Laboratory from January 1969 to August 1974. Following graduation from the U.S. Air Force Academy where he received a B.S. in Mathematics in 1965, he received an M.S. and Ph.D. in Applied Science at the University of California at Davis/Livermore. From August 1974 to July 1975, he attended the USAF Air Command and General Staff College at Montgomery, Alabama, and attended graduate school at Auburn University from which he received an M.B.A. in Energy Economics.*

Attempts to overcome these problems proceeded in parallel with preparations for deployment, generating dissatisfaction among scientists that ultimately erupted into arguments in the open literature about the apparently insuperable shortcomings of the ABM concepts. The developers' claims that they could somehow overcome these sortcomings ultimately could not be made good; myth could not substitute for the weaknesses of those sensors or foresee those yet to come. Personal and institutional divisions generated in those debates persist to the present.

Unfortunately, that debate essentially replaced one myth — that ABM could be made to work with the then current technology— with another — that for fundamental reasons, ABM could not be made to work at all. That shift buried the actual lesson of early ABM concepts: strategic sensors cannot be susceptible to precursor attacks and must be sufficiently mobile to avoid exhaustion. It was, however, correctly interpreted by some, whose efforts produced within a short period the infrared (IR) sensors capable of guiding robust strategic defenses. Their operation at wavelengths shorter radars' made them relatively invulnerable to nuclear effects and small enough to be mobile and even to be carried on satellites. Those developments not only overcame the specific deficiencies of earlier ABM concepts, but also made it possible to extend warning and engagement to all phases of the attacking missile's flight, opening the current round.

**The value of multi-layer defenses is particularly great against projected, highly-decoyed threats.**

The importance of multiple defensive layers was made clear by early analyses. Given only one defensive layer to defeat, the attacker could focus on it, making its execution difficult and expensive and its failure catastrophic. The value of multi-layer defenses is particularly great against projected, highly-decoyed threats. Against them, midcourse operation would give much more time for discrimination, and boost phase intercepts could eliminate decoys altogether.

The current thrust towards multi-layer defenses had its origin in the desire to make defenses resilient, but it soon became clear that they could make the defenses much more competent as well. In time, the advantages and feasibility of global coverage of submarine, accidental, and third country launches became evident. More recently, the flexibility that results from using limited, multi-layer assets in a preferential manner to enhance the effectiveness of initial deployments has become appreciated.

Current discussions, group defenses by the layers in which they act, which is the order used in the paragraphs below. They first discuss the boost phase— particularly the interaction of kinetic and directed energy concepts within it — then midcourse and terminal phases. Finally, they discuss the interactions between them. Technical details of the concepts are discussed elsewhere; this report concentrates on the interactions between them.

In the boost phase the primary challenge is to maintain enough lethality for it to bulk filter the threat enough to prevent the attacker from overwhelming downstream layers. That level of attrition is apparently feasible initially; maintaining it against a reactive threat becomes more difficult with time. The main concepts for doing so are kinetic and directed energy weapons (KEWs and DEWs), which are discussed in turn below.

KEWs are developed, lethal, and affordable. In near-term engagements with current, slow missiles whose launchers are distributed over large areas, KEWs should be cost effective by factors of 5-10. simple countermeasures to them do not appear effective. It is difficult to make booster decoys that are effective against wide-spectrum sensors, and boosters or buses that maneuver to avoid the KEWs incur a mass penalty that is greater than that of the interceptor by about the ratio of their masses, which is roughly 100-1,000:1. Better sensors are required, but the improvements are analogous to those for tactical sensors.

**Kinetic energy weapons are developed, lethal, and affordable.**

KEWs ' principal problem is the attacker's option of compressing the launch in space and time. In the mid term, he could reduce launch areas, booster burn times, and bus deployment times by about a factor of two, which would reduce KEW's margin to about a factor of two. On a longer time scale, new or mobile missiles could reduce the launch area essentially to a point. The booster deployment time could be reduced to the roughly 100 seconds required to deploy decoys effectively. If that was done, KEW effectiveness could fall below unity.

To negate KEWs, the launch would have to be compressed to its limits in both time and space. Just reducing one or the other would not negate them. This sensitiVity of KEW to the joint reduction of launch space and time, however, does provide an incentive for the attacker to develop fast missiles, if the defender does not pursue offsets to them in parallel. Some offsets lie within KEW itself. Since the cost per intercept Scales on the cost and mass of the KEW, reducing its size by a factor of 5-10 would make it possible for HEWs to maintain their effectiveness against even the most tightly clustered launches. An alternate approach is DEW, which does not share KEW's space- time sensitivities.

After several years of discussion, the scaling of DEW constellations on the main parameters of the threat now appears to be reasonably well understood. For nominal parameters the constellations appear to be modest in size, affordable, and scale favorably with the threat. Two aspects of that scaling are, however, less well appreciated. The first is the scaling of defensive constellations on the brightness of the DEW platforms, which is much weaker than previously thought. That makes it possible to address initial applications with smaller platforms, which could be available earlier than generally thought.

The second is DEW constellations' insensitivity to missile launch areas and times. Due to their speed-of-light flyout; they are relatively unchanged by the introduction of the fast missiles that KEW could reach only

**These differing sensitivities — of KEW to faster missiles and DEW to harder missiles — appear to be the basis for a usefully complementary deployment.**

with difficulty. DEW are insensitive to the missiles' overall engagement time, although they do retain a lesser sensitivity to further hardening of them. In time growth of the threat could make brighter, more advanced DEW desirable, but such platforms could apparently be introduced with favorable economics at about the point needed.

These differing sensitivities — of KEW to faster missiles and DEW to harder missiles — appear to be the basis for a usefully complementary deployment. If KEW were deployed first and DEW developed aggressively in parallel, no simple offensive counter could offset both. The development of DEW by the defense would in fact provide a disincentive for the attacker's development of fast missiles that would extend KEW's useful lifetime further.

While such a progression is logical and in accord with evolving technology, it has not until recently been the visible logic of the strategic defense program. Much of that program was based on the Defensive Technology Study, which worked intensively in 1984 to formulate a program supporting national objectives. It reflected the long-term nature of its charge as well as the research interests of its members, so it stressed DEW, and, in particular, the very capable DEW platforms apparently needed for the ultimate threat.

Subsequent reevaluations of the threat, and the recognition that early threats could be met with current KEW technology, led to a shift in emphasis to early deployments based largely on KEW. Then, as the possibilities for the attacker's exploiting space- time sensitivities of KEW were assessed further, the need for parallel development of DEW became clear and was implemented. While these shifts led to significant shifts in analyses, they had much less impact on KEW and DEW programs, which have apparently proceeded arguably about as rapidly as technology would allow. The issue now would appear to be maintaining the parallel, coordinated development of KEW and DEW.

In midcourse the problem is the opposite of the boost phase's gradual loss of lethality over time. In midcourse, inexpensive interceptors such as the ground-based exoatmospheric re-entry intercept system (ERIS) or KEW interceptors absent from the boost phase could apparently provide adequate lethality. The problem is discriminating the many credible decoys that could accompany each re-entry vehicle.

Near-to-mid term techniques are reasonably well in hand; Delta 181 experiment showed that current passive, radar, and IR techniques could discriminate initial decoys.Twenty eight Midterm laser DEWs should provide a useful interim discrimination capability. In the long term, as the decoys' ability, to simulate the re-entry vehicles — and vice versa — grows, more powerful techniques will be needed. It appears, however, that such tools such as neutral particle beams (NPB) should evolve from DEW about when needed, making the long term relatively secure. Their development is neither simple nor guaranteed, but they do offer the defense the prospect of a continuing advantage in midcourse.

There have been serious discussions of the defense's ability to integrate and act on this information in an effective, timely, and robust manner, but the current understanding of the issues appears to be that the issues are more tractable than those of existing strategic command and control systems involving large numbers of critical nodes that are at the disposition of the attacker.

A recently recognized aspect of the midcourse concepts is their ability to provide additional effectiveness during initial deployments, which involve largely indistinguishable targets sets such as missiles, communication nodes, and air bases. The boost phase layer will leave uneven numbers of attackers on various targets. By defending strongly those attacked lightly, a modest number of midcourse interceptors could save a disproportionately large fraction of that target set. While this advantage would diminish later when it was desired to protect more military and value targets, it would be particularly effective against attacks in the initial phases.

Early ABM concepts were essentially terminal systems, which were compromised by their large and vulnerable sensors. If much of the attack is met in the other layers, however, it becomes possible to restore the feasibility of the terminal sensors, since it would then no longer be possible for the attacker to count on exhausting the sensors with confidence. IR sensors, however, not only make survivability possible, but also support non-nuclear, homing KEW interceptors. Against a limited number of weapons, such KEW concepts could be quite effective in eliminating the weapons that leak through other layers.

Boost, midcourse, and terminal defenses might each approach about 90% effectiveness in the mid term. If so, against a threat of 10, 000 weapons, they would permit about 10 to penetrate. If one reached an urban area, the loss would be enormous, but still incalculably less than the 100-1,000 areas that would be lost in the absence of defenses. The arguments above indicate that this penetration should fall in the long term, but that remains to be demonstrated. Boost phase defenses and sensors must be pre-deployed in space, where they are continually exposed to harassment, attrition, and suppression. Their near-term survivability issues appear tractable. Initial KEW platforms would be small, so they could apparently assure survivability through a combination of hardening, maneuver, self-defense, and deception.

The issue is more subtle for the large DEW platforms needed in the mid term. The KEW techniques lose their effectiveness for all but the smallest DEW platforms. If, however, DEW platforms can discriminate decoyed attacks, which are the most stressing suppression attacks, the engagement essentially reduces to a one-on-one attack, against which DEW can defend themselves effectively. Interim DEW lasers appear capable of partial discrimination by producing thermal signatures or impulse. If that is confirmed, their survivability would not necessarily be much less than that of the smaller KEW platforms.

**Scaled versions of the strategic defense technologies could, however, be used to defend critical theater assets effectively, either preferentially or uniformly.**

In the long term, highly capable discrimination will be required against ever more sophisticated attacking sensors. In that time interval, however, discriminants such as neutral particle beams should be available. since their beams can penetrate objects, they can discriminate on mass, the one fundamental quantity that decoys cannot afford to simulate. Once such discriminants are available, it should be possible for them to protect not only themselves and nearby satellites, but distant sensors as well, which would relieve most of the platforms of the task of assuring their own survivability. If so, survivability of the whole defensive constellation would grow in the long term as such sensors were deployed.

The paragraphs above discussed the performance of defenses against large-scale threats. There is also a range of limited threats against restricted target sets such as the national command authority; command, control, and communication nets; submarine bases; etc. They involve strikes ranging from thousands of weapons on hundreds of targets down to tens of weapons on a few targets. Such strikes would be within the performance envelope of full defenses, so their effectiveness would not be determined by marginal economics alone. The physical and financial resources required to meet such limited threats can, however, be scaled from the KEW and DEW results discussed above. The costs involved scale down in proportion to the threat. The DEW platforms can be of significantly lower brightness, and modest numbers of platforms would be involved.

DEWs could be particularly useful for relocatable targets. They are quite difficult for current offensive concepts to treat, but present no additional complication for DEWs. If space-based elements were pre-deployed, the DEWs that were absent from the launch area would be oversized to handle submarine launches. Their global coverage would also suffice for third country launches and accidental launches, since boost phase interception eliminates the penetration aids that could overwhelm modest terminal deployments.

**It appears that developments in strategic and tactical sensors for missile and air breathing targets may converge more rapidly than is generally thought.**

A possible initial application of strategic defenses that would appear to have high leverage during the near-to-mid term is the active defense of Theater air bases and supply depots. Only a few tens of each such target exist, so they are attractive targets for conventional or nuclear pre-emption. Scaled versions of the strategic defense technologies could, however, be used to defend critical theater assets effectively, either preferentially or uniformly. In such defenses, the denial of post-strike information to the attacker is pivotal. Much of the information would be sought with prompt reconnaissance satellites, which could be negated by defenses derived from KEW and DEW concepts.

If missile defense is successful, it will still be necessary to defend against air breathing vehicles. Some strategic DEW concepts can be applied to air defense, e.g. lasers against low flying bombers and cruise missiles— once detected. Missile and aircraft detection involve some distinct issues, but it appears that developments in strategic and tactical sensors for missile and air breathing targets may converge more rapidly than is generally thought.

**Strategic defense concepts present at least partial, and in some cases full, solutions that appear effective and affordable.**

This discussion of limited options has only touched the surface of a whole class of sub-strategic applications, which are much more likely — and hence in some ways more important — than all-out exchanges. Perhaps the most important point, however, is simply that over the full range of applications discussed, strategic defense concepts present at least partial, and in some cases full, solutions that appear effective and affordable.

At a minimum, the introduction of strategic defenses must increase rather than decrease international stability for them to be useful. There are two principal dimensions to stability: arms control and crisis stability. Arms control stability examines whether the introduction of defenses by one side would induce offensive or defensive counter moves by the other side. Crisis stability treats the impact of their introduction on the pre-emptive calculus of each side in a crisis.

General discussions of arms control stability are somewhat complicated, but the essential result is simple:

ineffective defenses induce ones opponent to build additional offenses to offset them; effective defenses induce him to build defenses. That can be derived from considerations of national interest or simply from minimizing the cost of a given level of net defense. Either leads to the conclusion that for large threats, one should prefer cost effective defenses. Both sides do appear to act in rough accord with this calculus; it only becomes confusing when one or the other insists on developing concepts that are not cost- or interest-effective.

**There is still roughly a factor of 1,000 between the threat each faces and the threat either could currently defend himself against.**

Ideally, both sides should prefer eliminating the offensive forces altogether. Thus, that has been the goal of intensive arms control discussions for the last four decades. Those discussions have, however, been only marginally effective. There is still roughly a factor of 1,000 between the threat each faces and the threat either could currently defend himself against.

That margin could be overcome by reducing offenses by a factor of 1,000, improving defenses by a factor of 1,000, or changing each by a factor of 30. Such offensive reductions have heretofore proved impossible, and such defenses have not yet been shown to be feasible, but their joint modification has a chance. Reducing offenses makes defenses more effective, and developing effective defenses would make major reductions in offenses less risky. Thus, there is a feedback mechanism between defenses and offensive reductions that incentivizes the reduction of overall force levels.

This feedback is stabilizing so long as the defenses are cost-effective. Whether that criteria can be met is the subject of current debate, but it can only be settled by research and development. It is worth noting, however, that the mechanism described here is consistent with the apparent role of strategic defenses in initiating and incentivizing the progress of current arms control discussions.

The other dimension is crisis stability. Again, the general discussion is complicated but the main result straightforward. Crisis stability, the incentive for one side to strike first in a crisis, is not altered if offenses are reduced proportionally when defenses are deployed, the reason being that defenses enter the calculus essentially as negative offenses. In the simplest case, if the defender destroyed an offensive missile each time he deployed a defensive interceptor, each side's net offense would be reduced equally. The defender's would be reduced directly because of the offensive missiles he destroyed; the attacker's would be reduced because of the equal number of missiles the defender could now destroy in flight.

**At a minimum strategic defense technologies are capable of addressing the real and growing problems posed by accidental and third country launches.**

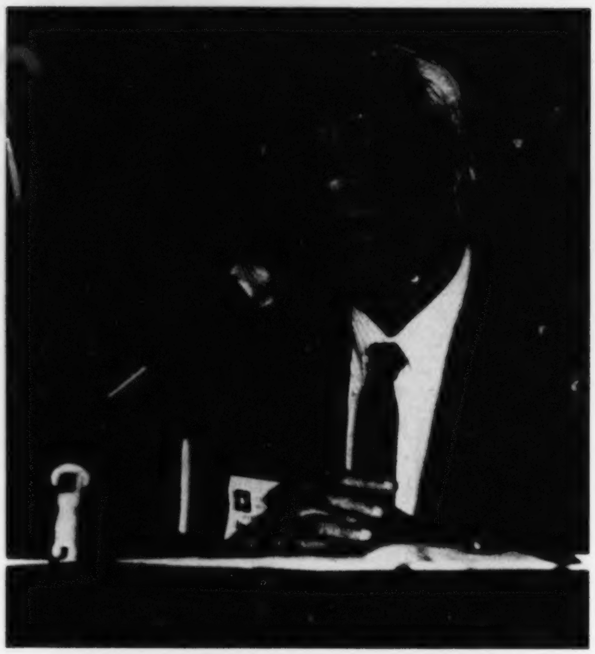
The analysis becomes more complicated as multiple-weapon missiles, finite kill probabilities, air breathing launchers, space-induced absenteeism, and the like are introduced. The logic, however, is unchanged, leading to counting rules analogous to those familiar for offensive arms talks. Discussing how these reductions balance should not, however, obscure the central advantage of such negotiations: they could lead to significant reductions in the net offensive forces of both sides, which in turn could significantly reduce the damage to the two societies should intentional or unintentional exchanges occur. That is a fundamental advantage, which persists to arbitrarily small levels of offensive forces.

Strategic defense technologies currently under investigation clearly overcome the weaknesses of previous concepts. Whether they will meet the new challenges that must be expected will have to be determined by further research and development. At a minimum they are capable of addressing the real and growing problems posed by accidental and third country launches. It also appears likely that they could address the spectrum of limited applications posed by sub-strategic threats. There is at present no reason to think that they could not ultimately attain the levels of capability required to induce significant mutual reductions of offensive arms.

How far strategic defenses could ultimately go will be determined by concepts that are now just in research. There is no known insuperable barrier to the attainment of the ultimate goal of negating offensive missiles, which represent the most stressing, and potentially mortal, threat to modern society. At present there are gaps in the science of strategic defense that must be bridged by myth, but research appears to be replacing it at a significant rate with a solid body of knowledge that leaves that goal intact.

**MR. MACLEOD**: Our next speaker has the award for coming the longest distance to attend this symposium, from Bangalore, India, representing the World Peace Council in Helsinki, Finland.

Dr. Satish Dhawan has extensive credentials. Most recently he headed the Indian Space Agency as Chairman; also, the Indian Space Research Organization. He was Chairman of the Space Commission, and Secretary to the government of India for space. He holds a B.A. degree in physics and math, an M.A. in English literature, a B.S.C. in mechanical engineering, all from the University of Punjab, an M.S. in aeronautical engineering from the University of Minnesota, and a Ph.D. in aeronautics and math from Cal Tech. He received the distinguished alumnus award from Cal Tech. He's a foreign Fellow in the U.S. Academy of Engineering, a Fellow of the Indian Academy of Sciences, and a Visiting Professor of Aeronautics at Cal Tech. Dr. Dhawan has agreed to take on this issue — speaking against the SDI. We're honored to introduce Dr. Satish Dhawan.



*DR. SATISH DHAWAN'S experience in the Indian space community is extensive. He joined the Indian Institute of Science in Bangalore in 1951, and was its Director from 1962-1981. In addition, from 1972 to 1984, he was the Secretary to the Government of India for Space, the Chairman of the Space Commission, and the Chairman of the Indian Space Research Organization. From the University of Punjab, he received a B.A. in Physics and Math, an M.A. in English Literature and a B.S. in Mechanical Engineering. He continued at the University of Minnesota, receiving an M.S. in Aeronautical Engineering, and received his Ph.D. in Aeronautics and Math at Cal Tech. Dr. Dhawan, now retired and living in Bangalore, is a Foreign Fellow of the U.S. Academy of Engineering, a Fellow of the Indian Academy of Sciences, a member of the Indian Space Commission and Chairman of the Governing Council of Raman Research Institute in Bangalore.*

**DR. DHAWAN**: Thank you very much, Mr. MacLeod. Ladies and gentleman, it is a pleasure to be with you again. Before considering the question of SDI and the promise which space technology holds, I suggest that it is useful to briefly consider the position of all advanced technologies. We consider this in relation to the overall condition of human beings in this world today. The proposition that all advanced technologies should be and must be pressed into large-scale use whether for the production of goods and services for markets or for military purposes and security is, I believe, patently shortsighted. So I suggest the proposition that the SDI myth is not that the purely technical aspects cannot be realized, the myth, if it does exist, consists of the assumption that this will be benign when deployed.

Events in the recent past, among them the Bhopal tragedy in India, the Challenger accident, and Chernobyl, have demonstrated very convincingly, that technology alone, even the most advanced technology, cannot by itself be trusted to be benign. Only human values, organization, perceptions, foresight, and really serious concern for the results and consequences can imbue technology and the fruits of the application of scientific knowledge with beneficial rather than harmful effects. I suggest that space is not free from this constraint.

**Events in the recent past, among them the Bhopal tragedy in India, the Challenger accident, and Chernobyl, have demonstrated very convincingly, that technology alone, even the most advanced technology, cannot by itself be trusted to be benign.**

Such considerations raise some fundamental questions regarding the view the world should adopt about the directions of development, not only of space but of all technology.

The energy crisis of the '70s and its aftermath has suddenly shattered the illusion that the degree of industrialization and per-capita consumption of energy and the size of military budgets were the only desiderata of civilization and culture. The polluted waters, the depleted atmosphere, acid rain, and the almost irretrievable damage to large areas of the biosphere and shattered economies stand as eloquent testimony to man's follies. Do we want SDI-enhanced pollution to make space unusable?

The developing nations, of which I come, have yet to come firmly to grips with this issue. In pursuing their legitimate desire to provide a decent and improved quality of life, they seem to have accepted the industrialized countries' pathway to development. The model adopted is beginning to show very clearly the disastrous consequences not only on the physical environment but also to the social and psychological well-being of people and communities. To these considerations one must add that the prevalence of peace is a basic requirement for human development.

So in examining perspectives for the development and the application of space technology (which is among the most advanced, complex, and rapidly advancing combination of technologies) we must not ignore some of the real concerns and problems characteristic of space systems.

**Do we want SDI-enhanced pollution to make space unusable?**

We all know space systems tend to be very expensive. They yield economic returns only when deployed to assist solution of large-scale problems which match the dimensions of satellites. But these solutions can work only when you work with them in a very sustained manner. This sustenance calls for a long-range policy both from the social and political commitments not only from space scientists, engineers, and industry, but also from the user community and generally the people at large.

But I suggest that in the case of the question we are discussing, you need to consult people at large, not only of one country but often in many parts of the world.

On the international plane, there is the question of whether the impact of large-scale space endeavors, such as SDI, are likely to be a destabilizing factor for society or an integrating and benign influence. Such questions cannot be without profound importance. Thoughtful people around the world have noted the dual nature of space applications; for example, the tendency towards centralization and concentration of decision-making in a few hands. Also the opposite, they do tend to subject themselves to access and decentralized use to very wide sections of people. Both things exist.

**The global arms race is already pauperizing the world economy, and it seems to us that the weaponization of space will drive the nail into the coffin with no chance of development to find a better alternative.**

Scenarios have been developed leading to alternative functions and manner of applications of space technology depending on the choice and the selection you have made of the social development objectives.

For instance, the global arms race is already pauperizing the world economy, and it seems to us that the weaponization of space will drive the nail into the coffin with no chance of development to find a better alternative.

To those of us who live and work in the Third World, it's increasingly clear that the "technical sweetness" of new technologies and the possibilities these open up for applications would need to be increasingly tempered by seeking to define and understand the desired social goals, and in getting some sort of agreement on the direction, the pace, and the scale of space systems deployment. Large-scale application of these technologies must be derived from felt and expressed needs of human beings and not the other way around. In this sense, it appears to us that the SDI represents a juggernaut. No differential equation or sarcastic calculation or computer simulation can really provide the answers. For the real solution, you must seek the answers from the men and women around the world.

It is possible to envision a future for space with two essential components: First, for science which essentially expresses the exploration of the solar system with dreams of beyond; and, secondly, an application component. The essential point to make is that the application aspect needs to be derived from a vision and assessment of the contribution it can make to the well-being of the people as a whole. You need very wide support for this. In any case, the funds are very large, and serious international cooperation makes very good economic sense, as we heard the other day.

I think it would be appropriate to say that the previously mentioned considerations are applicable in principle to the international systems as well as to the domestic space systems, and SDI is no exception.

For example, the regulation of the geostationary orbit and the management of the electromagnetic spectrum by the International Telecommunication Union affords a small but excellent example of this healthy evolution. What is gradually going on now is an acknowledgment by all of the reasonable and equitable use of the geostationary orbit and the possibility of access to all nations.

If you recall the discussions in the last few years, neither the pure technology push and first-come, first-served, nor the desire by some of the new nations to obtain sovereign rights in the orbit, neither of them has won out. To me it seems a good example of how space has provided an avenue for reasonable reconciliation of perceived conflicting interests. There is no intrinsic reason why such a pathway cannot be followed for earth observations from space, space exploration, space transportation, space stations, and space security, surveillance, and a peacekeeping system. Arthur Clark has been suggesting this in the peace sats.

For this to come about, on the other hand, one must recognize there are some imperatives.

First of all, we believe there must not be any threats to the space systems of any nation, and international systems deployed in space must be open to all with some ground rules. The inherent complexity of developing and maintaining fully reliable space systems in the naturally hostile environment of space, this is tough enough. We must keep space from manmade hazards, weapons, as well as debris.

A step-by-step process of dismantling and limitation of nuclear weapons and their delivery systems on earth could reflect positively in a more open and safe world.

I suggest that then we can save space, space can also be made a safe place, then we can fulfill its promise. So long as large land, sea, and air-based nuclear weapon forces continue to exist without severe international political restrictions embodied in treaties, there is no technological space wizardry which can disarm them. Therefore, urgent measures are really required to further the growing climate of disarmament and arms control. There needs to be much more active international participation to arrive at an upper limit on the number of military satellites which can be launched and kept in orbit by any country. This, I suggest, could lead to practical arms control measures which limit the military satellites of all nations to nonaggressive uses and effectively prohibit the placement of weapons in orbit. This would be a logical goal to work for and it would lead perhaps to an international ASAT ban treaty.

**So long as large land, sea, and air-based nuclear weapon forces continue to exist without severe international political restrictions embodied in treaties, there is no technological space wizardry which can disarm them.**

The legitimate uses of space for gathering and transmitting information does not justify the development and emplacement of weapons in orbit. Satellites have already demonstrated themselves as extremely capable and reliable instruments for establishing the transparency of the strategic balance and, along with other supplementary means, the verification of arms control agreements.

What is lacking is an agreed, open, and legitimate international regime on the information which is derived from the space systems which would allow sharing it in a manner not detrimental to the legitimate interests of any nation.

Recent events by which high-resolution satellite imagery beginning to be available to the public is a very positive development.

Clearly, during the currently evolving international discussions it would be eminently sensible to eschew all actions which are provocative, or which seem to be provocative, and which make agreements more difficult. The trend toward weaponization of space, of which Star Wars is a part, already raises obstacles for agreements to be reached. If agreement cannot be reached soon to keep space free from all weapons, then this would force many other nations to abandon their so-far-peaceful stance on the nonproliferation of nuclear arms and space weapons. This, indeed, would be a tragic and serious setback for the realization of the future and real promise of space.

Freeman Dyson has described a future in which space weapons proliferate without end, and I quote, as the technical follies future. He calls it a future of double folly: the small-scale folly of militarily useless weapons and the large-scale folly of unattainable strategic objectives.

He goes on to pose the "ends and means" question, arguing that it is important to clearly distinguish between the ends and the means. Means are important but the ends are even more so. A non-nuclear weapons and non-Star Wars and non-SDI world is a worthy end for all mankind to strive for. The means to reach this must, first of all, be moral; secondly, it must be political; and only lastly, they have to be technical.

Mahatma Gandhi went a step further and he insisted that the means employed ultimately determined the ends.

In spite of the difficulties and complexities of the issues, more wide — recent events have moved in a direction which has raised great hopes around the world. With the US/USSR agreement to dismantle and eliminate intermediate and short-range nuclear missiles, the arms control debate has taken on a new dimension, perhaps even greater complexity but, nevertheless, it's very hopeful the climate is now changing towards a comprehensive test ban and significant reductions in the nuclear stockpiles.

An important component would be the advance of the question of verification where space systems can play a very important and enhanced role, particularly if they bring in, apart from the two great powers, the international community. It calls for some means to assist in this process.

**A non-nuclear weapons and non-Star Wars and non-SDI world is a worthy end for all mankind to strive for.**

For many years the people of the world have been pressing their leaders towards world peace.

I draw your attention to the five- continent peace initiative which has been very widely supported around the world, among others, by statements, written statements, signed by over 100 Nobel laureates representing virtually every country in the world. It would seem that at this juncture, the main future for space lies in directions other than weaponry.

Space holds the key to planetary management and, hopefully, we can all agree on two important goals: first, in helping the world to manage the global earth/space environment and to assure sustained yields in the face of an unprecedented urgency to raise the living standards of over half of humanity while not unduly threatening those who have been more fortunate in the past.

And, secondly, this initiates a new era in international relationships in which the two great space powers, the United States and the Soviet Union, can join together to lead an international program of geospace exploration. Every space agency and country can be invited to participate to the level of their capacity and all can feel a part of this great endeavor.

We need to consider what has been termed as the "Global Commons," a part of the common heritage of mankind and not the possession of anyone.

The future of space will depend not so much on technology but on how the slow, difficult, and complicated struggle progresses to create sound international institutions on earth to cooperatively and manage this remarkable resource.

Almost everyone who has had the opportunity to step into space, cosmonaut or astronaut, has instinctively expressed heightened feelings and emotions on viewing the planet earth. Yesterday, you saw a very beautiful representation of that. This, may I suggest, is the perspective, not SDI.

Thank you very much.

**MR. MACLEOD**: Mr. John Pike is in a bit of a rush to get a plane. He is going to come up and speak somewhat cryptically, I am afraid.

Mr. Pike is probably the most visible, constant critic of SDI, most widely quoted throughout the country and, as he mentioned before coming up, a space cadet since age four. Mr. John Pike.

*DR. JOHN PIKE is the Associate Director for Space Policy at the Federation of American Scientists. He coordinates the Federation's research, public education and lobbying on space policy, including the Strategic Defense Initiative. A former political consultant and science writer, he is the author of over ninety studies and articles on space and national security, including the book* ***The Impact of US and Soviet Ballistic Missile Defense Programs on the ABM Treaty.*** *In June of 1983 Pike initiated the Space Policy Working Group, a weekly meeting of public interest and Congressional space weapons issue, and he chaired this Group through December 1984. Pike has been active in the formation and development of the National Campaign to Save the ABM Treaty. He is also on the Board of Advisors of the Space Weapons and Varification Projects at the Council on Economic Priorities, and the Executive Committee of the Progressive Space Forum. Pike is a member of the American Institute of Aeronautics and Astronautics, the Council on Foreign Relations, and the World Affairs Council.*

**MR. PIKE:** I regret that I am going to have to leave in about four minutes to catch a airplane. However, over the last five years of the SDI debate, the networks have given me ample opportunity to sharpen my critique to 11 seconds that they usually give me on the evening news. So perhaps I will be able to utilize the four minutes that I have remaining here. I probably don't need much more than that. Five years after President Reagan made his speech, if you don't know what you think about SDI today, you probably haven't been paying attention.

Generally the few people who haven't made up their mind about SDI, the question that they ask most is whether or not the program is going to work. I think that is the most important question about strategic defense initiative. Unfortunately, it's a deceptively simple question that has a very complex answer.

There are at least three ways of answering that question. Does the gadget work? Does the system work? Does the strategy work? The debate over the last five years has tended to equate technological virtuosity on the gadget level with political wisdom at the strategic level.

Will the gadget work? Obviously, given time and money we are going to be able to come up with gadgets that will be able to intercept individual missiles and individual warheads. However, over the last five years, the greatest technological progress that the strategic defense initiative has made is in identifying gadgets.

**The problem is not to stop a bullet, the task is to stop a shotgun blast with a shotgun blast, tens of thousands of missiles with tens of thousands of warheads.**

Five years ago when the magazine illustrators tried to come up with a diagram of Star Wars it was extremely difficult for them to do so because there were half a dozen weapons hovering over, different weapons concepts hovering over in boost phase, three or four different sensors trying to discriminate in the midcourse, et cetera.

Fortunately for the magazine illustrators, unfortunately for the advocates of the program, the cartoons have gotten much simpler. Many of the gadgets which appeared promising five years ago no longer appear so promising.

But equally unfortunately, the problem is not to stop a bullet, the task is to stop a shotgun blast with a shotgun blast, tens of thousands of missiles with tens of thousands of warheads.

There are two fundamental problems that you encounter at the system level. Number one, tying the weapons and sensors together; and, number two, dealing with all the things that the Soviets can do to make the system less effective.

Clearly, the battle management is going to be one of the key difficulties in generating an effective antimissile system. If you examine the trade literature over the last several years, look at all the various new weapons systems that are having difficulties, you don't have to read very many paragraphs before you realize that the problem that these systems are having is with software, and the SDI is not going to be any different.

Equally unfortunate, there are a number of things that the Soviets can do to make the system less effective.

Survivability is clearly going to be a very challenging task. We shouldn't confuse survivability with immortality, but I think that we have to recognize that in the real world of military systems, survivability is very expensive.

**All of this says to me that while the system might work fairly well some of the time, it is obviously not going to work perfectly all of the time. Something that technologists have long recognized; something that President Reagan has only recently come to appreciate.**

Why is it that I can go out to Seattle and buy a Boeing 767 for 70 or $80 million, and yet an airplane with the same range and payload capabilities if I wanted to get to the Soviet Union in it in the face of hostile Soviet actions, I have to go down to Northrop and pay half a billion dollars? The price difference between the 767 and the Stealth bomber is the additional cost of the survivability, a ratio of perhaps five or seven to one.

All of this says to me that while the system might work fairly well some of the time, it is obviously not going to work perfectly all of the time. Something that technologists have long recognized; something that President Reagan has only recently come to appreciate.

What can you do with a less-than-perfect defense? The Defense Acquisition Board last year laid down two possible missions for the strategic defense system: One of them is defeating a Soviet counter force attack, the other is dealing with a Soviet retaliatory strike against the United States.

I have difficulty understanding the requirement for dealing with Soviet counterforce capabilities given the survivability of our bombers and submarines.

If the Soviets were to attack our land-based missile forces, they would do little except make us extremely angry with them without doing anything to reduce our ability to make them very unhappy in turn.

It's true that a less-than-perfect defense, in combination with a capable counterforce or armamentarium, would give some damage limitation capability to the side that went first in a time of crisis. I'm not sure that the United States would decide to initiate such an attack. I'm perhaps less confident that the Soviets would decide not to initiate such an attack, and I certainly wouldn't desire to erect a system that would give them such incentives. Unfortunately, it seems to me that the vulnerable, less-than-perfect, ineffective defenses of the type that are going to be technologically feasible over the next several decades would only increase the risk that one side or the other would decide to initiate the use of the nuclear weapons in order to limit damage from the other sides retaliatory strike.

Given that the devices are going to work but the system isn't going to work very well, I'm unable to identify a rational military mission for this system.

**MR. MACLEOD**: If we could have our panelists come up front to the table, we will take some questions and answers.

Let's start with some questions that are addressed in general and we'll have the panelists who feel comfortable go ahead and have at them.

"Without SDI it was general talk, but with SDI the USSR has come to the table for serious peace discussions. Is the SDI a myth or reality in the movement toward long-range peace in the world?"

**DR. CANAVAN**: I agree that the prospect for arms negotiations and reductions and the prospects for mankind do appear to be better.

The question is, is that due to SDI? I could answer that in two different ways. There's been a slowly convergent body of thought, on the subject of strategic stability, arms control stability, crisis stability, and what the heck defenses do to that that has been worked out over the last few years. That theory is perfectly consistent with the fact that the Soviets would see the value of large-scale arms relations simply because defenses that cost-effective tend to give everybody incentive to build the defenses rather than the offenses.

Now, most of that stuff is very mathematical and tends to be overly quantitative. There is a beautiful description that I just read in the most recent book by Freeman Dyson which I think is called **Infinite In All Directions**, and he has a chapter on SDI in which he says that we have a factor of a thousand to go between what we can do to defend ourselves and what both sides see as the threat to them. Arms control by itself has shown no ability to bridge that gap, defenses by itself are questionable, but between the two, you might possibly be able to produce the ultimate goal of reducing nuclear weapons to a level where we no longer threaten the annihilation of everyone.

**GENERAL GRAHAM**: I might add just a note to that. I think even the harshest critics of SDI agree that the Soviets are back at the negotiating table and that there has been considerable movement in the arms control arena because of SDI. Now, those of us who are not such harsh critics of SDI believe — that nothing much played anywhere near the same role that SDI did in getting the Soviets back to the table, keeping them there.

The trick is to make sure that you keep SDI alive because the minute they reach their primary foreign affairs goal — and its not just "I" saying that this is their goal, Gorbachev says this is their goal — to kill SDI — then you will see them cheat on what they would sign and the urge to get to further arms reduction would stop.

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**I think even the harshest critics of SDI agree that the Soviets are back at the negotiating table and that there has been considerable movement in the arms control arena because of SDI.**

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We've got to remember what the status of arms control was when President Reagan said he wanted to go in this direction and how quickly it changed after he said he was going to go SDI.

**MR. MACLEOD**: For Dr. Dhawan: You referred to weapons in space; yet, Dr. Smith indicated that SDI is not effective as an offensive weapon. Do you really think the U.S. SDI is an offensive program?

**DR. DHAWAN**: I prefer to rephrase the answer and the form. I think it's trade in perceptions. If the deployment of a weapons system by one party occurs, then the deployment of a weapons system by the second party will occur. If you put weapons in space, they're bound to be used. The military history is that no weapon that was deployed was not used. The only exception to that is the nuclear bomb, which was used but since that time has prevented war, unconfidently, in the last 40 years.

I, for one, would be very uncomfortable to have ground base weapons being deployed when your satellites and your systems are already unreliable.

I think, with the deployment of weapons in space, one must be very careful. They must be absolutely necessary and you must have a total agreement on when and how they are going to be used. You must not only have two parties to this game, there is an international community even within the allies.

**GENERAL GRAHAM**: Can I answer that one? I think that, Professor, you and others don't seem to realize that space got militarized by Werner Von Braun when he fired 1500 weapons through space at London and Antwerp a long time ago, and that every one of those ICBMs, that people like myself and SDIO want to shoot down are space weapons. Sure, they spend a couple of minutes in the atmosphere. The rest of the time they go charging through space and do enormous damage. So that is the kind of weapon I want to keep out of space and that's why I'd like to see an SDI system up there to keep them out of space as best we can.

**MR. MACLEOD**: For Dr. Canavan or General Graham: Does the length of time required for determining an attack launch has begun — and for the U.S. command authority to respond — allow for boost-phase targeting?

**DR. CANAVAN**: Well, let me speak to the impractical perfect world. If you go through the mathematical analysis or the time lines for classification alert, activate systems that are initially in a passive mode, there's an interesting property and, that is, if you look at the time lines of the threat and the time lines that you can give a release and operate, it looks like you can always make it with some margin; that you have a wider margin in the near term when the missiles in the boost phase take a much longer time. Then it gets more strenuous later on, but there's always a nonzero opportunity for man to live.

I was asked to do that question by the JCS about a year ago and I was really quite surprised that that's the way it came out. Of course, if you burden the system down further and further you can make it not work, but you have a shot in the boost phase.

My comments were with respect to the boost phase because that's the most stressing. All the phases are not much impacted by wartime.

**GENERAL GRAHAM**: You know, on that score, we don't need to do any more with SDIO, in my view, than we do the offensive. What the President should decide is not whether to shoot down a given missile, the President should decide what level of alert we should be on, and at some level of alert, when things are really getting dicey, like, we have a Cuban missile crisis on, I would like to have the President be able pick up the hot line to Moscow and say, "Don't send up an astronaut today because anything that comes up, we're shooting it down. We're nervous." I think we should put ourselves in a position to do that so that nothing goes into space, including those awful weapons I was talking to the professor about.

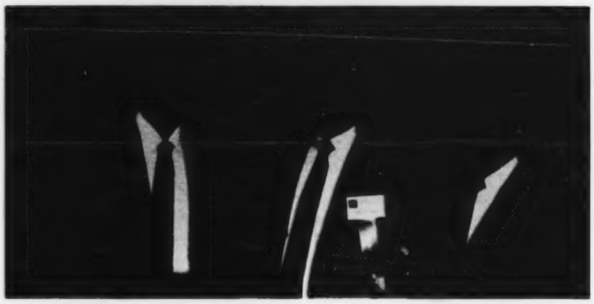
Then you can have another level of alert and say, "Well, there's a man in the loop for every one of them up to a certain number of launches, whatever that might be.

It would be a number of launches that means we're being attacked or one of our allies is being attacked." In a normal peacetime situation missiles are not to get shot at unless the man in the loop says so. When you look at it that way, then the command and control problem becomes a lot easier.

**MR. MAC LEOD**: Dr. Dhawan: If you oppose SDI in the U.S., do you condemn Russia's militarization in space with their ongoing SDI program?

**DR. DHAWAN**: Unfortunately, this is not the platform to condemn them. The issue of world peace is not taking sides between the Russians and the Americans. This is my personal view. I'm on the side of humanity who doesn't want war, and lest I give you a wrong impression, I have the greatest admiration for the military people of all countries who defend their country. I distinguish between militarization in space and weaponization in space.

As the General has pointed out, everybody knows that from the word "go" the military has used space, and by just this usage, like many things in human affairs, legitimatization of acceptance by large numbers of people of spying. You call it "reconnaissance," getting strategic information. Interesting words. All it really means is getting to know whether your neighbor is getting ready to attack you. This is information-gathering, to the heart of the military systems, certain levels of the space variations, and gradually of all men in the rest of the world. I have no objection to that.



My point there is that we're opposed to any increase of the danger of nuclear war, whether in space or anywhere else, never mind who does it. In that connection, space is the high frontier of technology.

Now, it is a moot question whether they stop testing. You do recall a time when unilaterally they stopped nuclear tests, and it's a puzzle to some of us, why the USA did not show the world they can also stop for a while, discuss across the table, and if it doesn't work out, we will start testing again.

But world opinion in this matter carries some weight, and I would suggest to this distinguished audience that I don't think you should treat the peace movement of the world as a controlled movement of the USSR. Such events I know I have not been so intimated in our world peace movement, but moving around in India, countries nearby now, you notice a ground swell amongst the lawyers, the doctors, the engineers, the scientists, everywhere.

And there is this question.: What are the Soviets doing? We have often criticized them, but they used them very specifically, but this is a change and I think it's a change that's very good and I support it.

**DR. CANAVAN**: I don't want to disagree with the call for peace, but I am getting confused now about the nomenclature, the business of weaponizing space. It seems to me that I have not heard anything discussed in this room today that would be viewed as weaponizing space in any sensible way.

The Soviets raised the possibility of using space while on SDI in Geneva about four years ago, and a number of people, myself included, wrote papers on the subject, concluding that, it was not even a second order of consideration, third at best. The Soviets dropped it.

I know of no one of a technical bent who would care to step up here and argue that any of the things that we have heard about are in any meaningful sense weaponizing in space, and the notion that if you put them there, they're going to go off and these platforms can't hurt anything on the ground, the only thing it can hurt is something that's coming at us. Other than that, there's no way for them to go off.

So I think that we are debating about, certainly, a logically insignificant point there.

**MR. MACLEOD**: For General Graham: The US and USSR do not own space. Have you asked the other four billion people if that's what they want done with space?

**GENERAL GRAHAM**: Well, the United States doesn't own the high seas either, but I'm not going to ask everybody in the world whether we can put ships out there.

I think that the big problem we have is getting Americans to focus on what they support. They consistently support SDI, at a rate of about three to one in poll after poll after poll. The last one being the exit polls on the Super Tuesday votes, three to one in favor. 60 percent of Americans don't know that we can't even stop one ballistic nuclear missile, fired by anybody, even by accident. So we've got a great education problem even with the American people. Now, if we tried to educate four billion people who are even less technically astute, I doubt we'd succeed.

If you make a case that the United States has no right to use space to defend itself, I just totally disagree with that. I think we have the right to use space and the high seas and the air and whatever we need to defend this country, make sure we don't get clobbered by nuclear weapons.

**MR. MACLEOD**: Here's another question for General Graham from Jerry Laws of the **Houston Post.** What evidence have you to say Russia has assassinated Russian scientists? Who were those scientists?

**GENERAL GRAHAM**: Well, one was the chief scientist of the Seimeus Company. And the reason? I'm not asserting it. A note was left by the Red Army Brigade of

Germany saying, "We killed this man because he's involved in SDI.

Another was a Lieutenant General who was heading up the SDI effort in Italy who was machine-gunned in his automobile and they left a note and said, "We killed him because he was in SDI." And that's only two.

Well, there are three cases where the Communists said that that's why they did it, and there are about nine instances of mysterious deaths, murders, and perhaps suicides of scientists in Europe connected with SDI.

**MR. MACLEOD**: Dr. Dhawan: It is recalled that India developed nuclear weapons and has conducted a nuclear weapon test, namely, a nuclear weapon test in the atmosphere. With India's interest in missile development, do we anticipate India marrying these two technologies, nuclear weapons and missiles?

**DR. DHAWAN:** I wouldn't like to speculate, neither do I represent here any belief for India.

To the first question I would say, to set you right, that the nuclear test which was done, so-called P & E, was underground, not in the atmosphere.

On the question whether India would take the step of marrying nuclear technology with missiles and do something, I really can't tell you what it would do. The official stand, as far as one can see, which is supported by Parliament and generally the people, is not to do it.

However, I must say that with what's been happening in that part of the world, there is pressure, there is a lobby, a very strong lobby, who are thinking to wait, but go nuclear and build up a resistance. The reason for that probably is India's experience with China, with Pakistan, and with the arms supply efforts that go on. I would say as an individual, that I am personally against nuclear arms, regardless of what happens anywhere else in the world. I don't think there's any nuclear threat to India. I don't see any reason, at this stage of development, why one should divert anything from providing a good life for the people.

What will they do? I'm afraid I don't know.

**GENERAL GRAHAM**: You know, this brings up a very serious question with regard to SDI. The urge of nations who do not now have long-range ballistic missiles with nuclear weapons or even long-range ballistic missiles with biological or chemical weapons will remain great so long as there is no way to stop such a weapon. This is one of the reasons why SDI must go to space. It must go to space so that there is a capability to prevent a long-range ballistic missile from India, say, firing at China, or vice versa, or at Pakistan, or the Saudis firing their 1300-nautical-mile missile at somebody or Khadafi buying the 800-mile missiles from Brazil and firing them at somebody. And ERIS systems that are just on the ground in the United States is not going to prevent that sort of thing.

We must have space defenses to prevent this kind of catastrophe and to stop the constant urge that I'm sure Dr. Dhawan and his people who think the way he did will urge India not to get those weapons. But there will be people say, "We've got to have them," and sometimes the "we've got to have them" people are going to win the argument and you can see it happening, you don't have to listen to me. Read your newspapers and see the proliferation of a long-range ballistic missile because there is no way to stop it. How can you convince somebody you shouldn't try to get a weapon that, whoever your opponent you think might be,cannot be intercepted? So this is another superb reason for getting SDI and getting it in space, not just Sam Nunn's ground-based systems, but space.

**DR. DHAWAN**: While I agree with the General on one point, the proliferation part I deplore. I'm afraid I disagree with the other part basically because the assumption there is that some nations have the God-given right to be policemen for the rest of the world. Now, I think if you have to have policemen, don't arm the policemen.

You remember the good old days, it was the legend of the London bobby. He didn't carry any guns. There is a danger that if you proliferate missiles that irresponsible people, governments, would perhaps use them and that would be a tragedy for the world.

How are single missiles going around in the hands of people today? Nobody can police them. What's happening with those silkworms? Everybody denies them. All big nations say, "No, we are not doing it." But what are the facts? The dead people don't speak.

**DR. CANAVAN**: There's a small mathematical point to be made here with respect to policing the world and, that is, instability here or instability there, however you want to put it, with offensive nuclear systems guaranteeing the world, the most stable system is one where one nation has it; the next most stable is where only two people have it, and then after that things really go downhill very rapidly, which is why we worked so hard on ASAT, for instance, over the last few years.

The real problem is that it is hard to control nuclear weapons, offensive nuclear weapons. The technology is pretty much out, it's a matter of materials. You can see this problem getting worse, and mathematically it gets worse year by year, and I think the point that General Graham was trying to make here, is that this awkward instability is not a property of the defensive systems. You can make a stable "policeman" that knocks down all the unauthorized launches that go shooting from wherever to where. You do need to put it in space if you want it to be maximally effective. Defenses produce enormous stability in the global sense.

**MR. MACLEOD:** For Dr. Canavan and General Graham: SDIO has so far spent over $10 billion and is still a long way away from being ready to field a shield. In some single cases as much as a billion dollars has been expended just to try to define what to do; for example, the boost phase surveillance system. Isn't there a less expensive way to develop a reasonable shield sooner and still have the limited resources to also make sure we can maintain a reasonable sword?

**GENERAL GRAHAM**: Well, I'll take a shot at that because I think everybody who knows what High Frontiersmen have been saying all along is that the technology is there. As a matter of fact, just day before yesterday, I was talking to the President and he repeated his, "Well, you know, we're going to research it, develop it, test it, and when ready, we're going to deploy it." He says, Doesn't that take care of it?"

And I said, "No, sir. It's that 'when ready' which I'm not sure is a necessary modifier. I said, "I want you to do something else." Maybe he will and maybe some of your companies will be involved because I named a bunch of good companies. I said, "I want you to appoint somebody like Dave Packard, somebody who knows both the industry and technology, and have him answer this question which you have not put to the SDIO people, nor has anybody put to the experts: If I order a defense in now, what would I get? What could it do? What would it cost? How long would it take? What would be the technological risk, and what would be the difference between a Manhattan project-type management as opposed to current Pentagon management?

And I said that to him because I am convinced that there are systems that are simply ready to go right now and have never been put forward because of the constraints on the charter of SDIO. I don't blame Jim Abrahamson, I don't blame Gordon Smith. What I blame are some of the elements in the Pentagon itself who tried very hard to make sure it stays research, because the day that SDI pops out of research, certain other big programs — and I could name them, and so could you — will go right down the toilet because the rationale for them will disappear if we've got any kind of reasonable active defenses. This is being resisted within the Pentagon and the SDIO can't do much about it until somebody asks the right question.

Now, I hope that this administration, before it leaves and you get somebody in who whose baby this is not to at least examine the "when ready" aspect of his current formula on SDI and see if that is in fact a necessary modifier to Reagan's position on SDI.

Short answer? Yes, there are things that can be done, can be done right now.

**MR. MACLEOD**: I am going to ask each speaker to take two minutes and give a wrap-up. Is that close to what you have just done?

**GENERAL GRAHAM**: Well, I think I just wrapped up, so you can give it to the other fellows.

**MR. MACLEOD**: Dr. Canavan.

**DR. CANAVAN**: Well, I would like to state that I am in vile agreement with everybody here which kind of bothers me. I think you have stressed that it would be very desirable to reduce the burden of military arms around the world to do something to make this all safer, and I agree.

I think the only point on which we would depart is on the means for how to do it. If I were to sit here and say strategic defense could change the world in which we work enough to where we would have incentives to reduce offensive weapons enjoinment with the Soviets (and, by God, we would do so in a way that we would reduce the expenditures that would go into these military systems), then I would think you would agree that would be a reasonable thing to do. The reason I say we agree — well, that's the goal and that's the means.

I guess what I'm saying is I agree with you in the following sense, that is, that the day that I believe that strategic defense could not do that, could not induce mutual reductions and a better world, then I'd quit voting for it.

What I didn't tell you earlier is on the three previous ABM debates I voted against on all three and I'm still holding out on this one. If I could believe that strategic defense could reduce expenditures and improve security, I would be for it, and I can see no rational alternative to that position.

**DR. DHAWAN**: I appreciate your position. I can only reiterate that the rest of the world would like the present process of reduction of nuclear armaments and severe restrictions agreed to by the two main adversaries and ratified by some treaty to which other nations join, some international system of verification.

I don't see how putting weapons into space is going to prevent nuclear war. I mean, A and B, if you don't want to use names, are the two adversaries today and the whole world is held at ransom.

In human affairs, kindly look at the democracy of America. Each American is a citizen. There are instabilities all over the place. How the hell does this country work, then? And, believe me, from where we sit you work wonderfully well.

I agree with the strategic debates, people saying, "Well, if you give it to more people this is going to happen." I agree then. However, what is the antidote to that? The antidote, we're not convinced that it's SDI, whether its knowledge, as President Reagan said, is shared with the world.

Look at the production of arms today, look at your state departments and DOD's requirement that defense knowledge must not be shared. How are you going to change that mentality around the world overnight? Share Star Wars? Impossible.

So I suggest that you think about SDI. But look at another viewpoint which says, okay, let's put that proposition aside for a while. Let's start from a different viewpoint. Let's assume that the world can be brought to a stage where the nuclear weapons are not perhaps to zero. I think the nuclear weapons' presence between the two main powers have demonstrated some degree of stability which most people around the world, most governments understand. Let's get to that position.

In the meantime, let us not throw away the United Nations. That's the only one we have. It's not perfect and, believe me, some of us are most critical about the U.N. who come to our countries and live in air-conditioned palaces and try to help the villages. It's disastrous. Our countrymen do the same.

The U.N. came out of a trauma of World War II. Why did it come? It wasn't any given nation, they all came together. That's a peaceful process. Let's not destroy that imperfect U.N. system. That's the only treaty system which has worked for 40 years. So I suggest that the anecdote to SDI is a discussion process which eventually reduces armament to a limit which is understandable, doesn't pose a threat, and the counterbalance of a development process which is healthy for everyone. I know there will be difficulties, but let's work for it.

**MR. MACLEOD**: I thank each of the panel members for taking the time to come here and laying out the issues as they have.

The exhibits are open and there is a special display of Holorama from France. They refer to it as a less expensive version of Holography. It's a fascinating exhibit that has been brought over from Paris.

We have some new laser posters which just arrived today that depict the history of the space program. These were printed for us by the Cernan Corporation, Gene Cernan's company, and they're available on sale at the gift shop.

Thank you very much.

# Dinner

## FOURTH NATIONAL SPACE SYMPOSIUM BANQUET

*MC:*
**Dick MacLeod,** Executive Director,
U.S. Space Foundation

*Moderator:*
**Gen. James E. Hill**, USAF (Ret.),Chairman,
U.S. Space Foundation

*Speakers:*
The Honorable **Roy Romer**, Governor of Colorado
**Doug Morrow,** Academy Award winning Writer, Producer
**Edward Teller**, Associate Director Emeritus at Lawrence Livermore National Laboratory

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**MR. MACLEOD:** Ladies and gentlemen, good evening and welcome. We're delighted to have you here at the banquet celebrating the Fourth National Space Symposium.

At this point, I would like to introduce some very special guests we have here to greet you; and before I do that, I want to acknowledge that we have in this crowd more presidents of corporations and divisions of corporations, even more senior vice-presidents than ever at the Symposium. We just can't go through all of those, and at the risk of hurrying, we're going to suggest that we introduce our key guests at the head table, along with speakers, and astronauts.

First, I am honored to introduce to you the Honorable Roy Romer, Governor of Colorado, and Mrs. Romer.

The Secretary of the Air Force, Edward C. Aldridge, and Mrs. Aldridge; the Administrator of NASA, Dr. James C. Fletcher, and the Chairman of the U.S. Space Foundation, General Jim Hill.

We also have with us tonight the former Secretary of the Air Force, former Chairman of COMSAT and several other corporations, Dr. John McLucas.

From the Air Force, the Commander of the Air Force Space Command, Lt. Gen. Don Kutyna and Mrs. Kutyna.

From the Department of Education, the Assistant Secretary of Education, Mrs. Beryl Dorsett.

From India, the former Director of the Indian Space Agency and representing the World Peace Council at our Symposium, Dr. Satish Dhawan.

The Director of the Apollo Project from the time of the challenge of John Kennedy to the first landing, General Sam Phillips.

And among the astronauts, we have here tonight from the original Mercury 7, Deke Slayton; one of the first two humans to land on the moon, Dr. Buzz Aldrin and his wife, Lois; from the shuttle era, representing Bechtel National Corporation, Dr. Ox van Hoften and his wife Valerie, and also, now representing AT&T, astronaut Terry Hart.

In addition I would like to introduce a special guest of ours tonight who just started a major project with the U.S. Space Foundation by tying into our computer net which was donated by Hewlett-Packard. This is the gentleman, located in Sidney, Nebraska, who has come up with the funding to allow us to go on with our project to allow teachers to dial in and find lesson plans, NASA materials and FAA materials, and as of today Civil Air Patrol materials from the U.S. Space Foundation Space and Aviation Education Resource Center, Mr. John Egging.

Among the very special people here tonight, sitting amongst you are those who have really made all of this possible. We could not put on a function of this nature, of this magnitude, and receive some of the compliments that I have been hearing today, without some 150 volunteers who have been working — many of them over the past several months — and many of them who have given up at least a week of their annual vacation to work this week for the U.S. Space Foundation. Will all of the volunteers please stand.

If you have ever run a party of any size, and you look at adding in three luncheons, two major dinners, bringing in almost 70 speakers, meeting every single one of them at the plane and taking them to their room, getting them back again, and making sure all of the transportation goes right, all of those meals go properly, everybody gets on and off properly — that's what those volunteers do — you have an understanding of the amount of detailed work these wonderful people are doing for us.

I would also like at this point for the relatively small U.S. Space Foundation staff, Chuck Zimkas and the rest of the staff, to stand.

A lot of people say things like "they're terrific," "they're overworked," "they're underpaid — and I've said those things myself. But you can't really realize what goes into something like this without realizing the amount of effort they and their spouses get involved with when we really go to town to put on this Symposium; and at the same time plan for our summer sessions at the Air Force Academy for the teacher workshops; and at the same time handle all of the normal business of the Foundation. They've just done a terrific job.

At this point, now, I would like to introduce our entertainment for the evening.

We have a rare treat because we have a group from the U.S. Air Force Academy that some of you know called the Moods in Blue. The Moods in Blue normally appear as part of a large stage show. Tonight they're going to appear a cappella, and momentarily, they'll be coming on up as the stage rises from down below here and lifts, just as the Air Force always does, heads up to the skies.

**MR. MACLEOD:** What a terrific way to begin an evening.

At this point, I would like to ask Dr. Fletcher and Gen. Hill, as well as Hal Bacon, Phil Woodruff and Dr. Bob Brown to come up on the stage, please.

We have in Colorado Springs now, something that is unique in the United States. We started out working with NASA to become a NASA teacher resource center. About a year later, we became an FAA, Federal Aviation Administration, Resource Center, and as of this past month, a Civil Air Patrol teacher resource center. We are the only place in the country that has all of those as resources in one public place.

In addition, your United States Space Foundation is now producing more video tapes for teachers per month than Johnson Space Center.

That's all done without cost to the teacher, except for the basic cost of a blank tape, and we use both volunteers and high school students to make those copies.

Tonight we would like to have Gen. Hill present a certificate of appreciation from the U.S. Space Foundation to each of these gentlemen for their work and their vision in bringing together these tremendous resources in one place for teachers all over the country. Gen. Hill, Dr. Fletcher.

Gen. Hill is going to come back up momentarily, because we have another program to highlight. It started just after the Challenger tragedy. Groups all over the country started raising money to emphasize that the American people wanted a new shuttle. A number of people, including Senator Jake Garn and others, said "we need someone to organize these various groups. They're well meaning, but they're not sure exactly how to properly go about raising funds with nonprofit status. We formed what was known as the Challenger 7 Fund.

With typical Colorado Springs backing, the First National Bank started out the fund with $10,000 and then made arrangements with the post office to go over there daily, and they have been doing that up to the present, to pick up mail addressed to Box 51L, the shuttle-designated mission number, bringing that over to the bank, depositing the checks that were in it, giving us the receipts and the letters. Our staff would then take care of mailing out thank you's. Those thank you's were full color, very nicely done, drawn by artists provided by Gary and Dusty Loo/Looart, at the time Current Greeting Cards, all donated, printed by Gowdy Press, all donated, full color, and they have been going out all over the country for these last couple of years.

Tonight we're proud to present a check to NASA. We had to wait this long because the law had to be changed to allow NASA to accept such a donation for a specific purpose.

But it's been changed, we can do it now, and if we can have Bruce Kopper come up here, our Secretary/Treasurer, he's the guardian of the dollars, a check for just about $145,000.

**GEN. HILL:** Ladies and gentlemen, it is my pleasure now to be able to introduce our guest speaker tonight. We are honored to have the 39th Governor of the State of Colorado as our speaker. Governor Roy Romer is a veteran political and business leader in Colorado. I have known him since he was elected Governor. I actually knew him a short time prior to that, and I have enjoyed the privilege of working with him.

He was inaugurated as Governor of Colorado on January the 13th, 1987. He was previously the state treasurer, holding this post from 1977 to 1987.

He was a member of the Colorado Senate from 1962 to 1966, and, as Colorado Governor, Roy Romer has placed special emphasis on reactivating the state's economy. I can vouch for that personally, as I've indicated I've worked with him on that issue. We've had a number of successes, and we've had some failures — but he's been a very active and progressive Governor in revitalizing the economy of the state of Colorado.

He also has special concerns about the quality of Colorado's educational system, including public schools, colleges and universities, the preservation of the Colorado quality of life and open space and the construction of needed public improvement projects. Governor Roy Romer has been a very active and progressive governor for our state. He is certainly changing the atmosphere for business in our state for the better. Please welcome Governor Roy Romer.

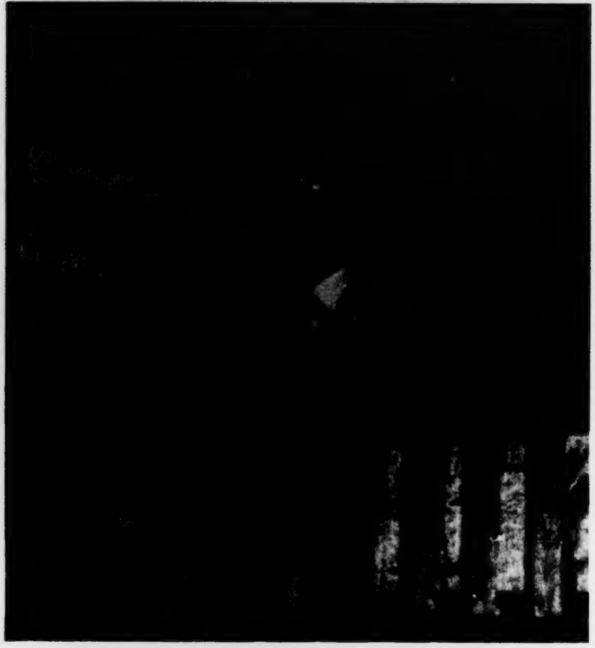
**GOV. ROMER:** Thank you very much, Jim. I want to welcome you to Colorado. I'm always a little bit in awe when I come to this particular gathering because, I feel some kinship with space flight. I happen to be a pilot. I began to fly in an Aeronca tandem in 1945 out on the plains of Eastern Colorado. I bought it for $400, and there was nobody in my little town of Holly, population 902, who knew how to fly. So I had to catch itinerant pilots who came through town, and they finally taught this young fellow to fly.

**Space is absolutely central to what's happening in Colorado.**

I have had an attraction throughout my life to flight. I used to own and operate a fixed base operation. I used to own and operate a flight school, and I seem to continue to return to this business of piloting. As I went through your exhibits tonight, before I came in and joined you in the meal, I was again struck by what has happened in my lifetime.

I want to speak about that, but first I want to tell you how we in Colorado approach all of you in this room, and your interests in space.

We want to make a place here in which you feel welcome, you can prosper, you can experiment, you can explore.



*ROY ROMER, the 33th Governor of Colorado, is a veteran political and business leader in the state. Inaugurated as Governor of Colorado on January 13, 1987, Romer previously served as state treasurer. He held the treasurer's post from 1977-87. He also was a member of the Colorado House from 1958-62 and a member of the Colorado Senate from 1962-66. As Colorado governor, Romer has placed special emphasis on reactivating the state's economy. He also has special concerns about the quality of Colorado's education system, including public schools, colleges and universities; the preservation of Colorado's quality of life and open space, and the construction of needed public improvement projects. Romer's business activities include: owner of a chain of construction equipment stores in Colorado, Virginia and Florida; developed a portion of Colorado's Centennial Airport, ran a flying school and owned and operated a ski area. Romer received a bachelor's degree in agricultural economics from Colorado State University, a law degree from the University of Colorado and studied ethics at Yale University.*

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Space is absolutely central to what's happening in Colorado.

Space exploration.

This economy, and the attitude of those of us in public life in this state are absolutely open, even aggressive, aggressive to those of you in the space industry.

I want you to get to know us better. We have a critical mass developing here in military, civil and commercial space activities.

We have a place that I think will become — even more than it is now — the space capital of the world, and I feel that it is absolutely critical that we work together to make that happen.

Let me say why space captures so much that is unique about Colorado.

I've always viewed Colorado as a part of the West, a part of the frontier. As I have experienced a bit of the frontier myself, as I have read about it, I think of the attributes that make men and women want to explore, want to pursue the unknown, push the outside edge to see what's there. And, as I think about where that is most symbolized in the lives that we now live, it's in space exploration.

**Space exploration is critical to the economy of this nation, and this world, but more so it's critical, I think, to the human spirit.**

Space exploration is critical to the economy of this nation, and this world, but more so it's critical, I think, to the human spirit. I don't think that human potential is ever sufficiently fulfilled unless you're exploring the unknown. The exploration of space not only gives us new knowledge of what's out there, but gives us a unique opportunity to look from out there to back here, and to understand the earth's sciences better.

That's happening in a whole lot of places. It's happening in the University of Colorado. It's happening here at the Symposium.

**Space exploration...is something that symbolizes to me that restless spirit in all of us, restless to find out what's out there, to learn what we don't yet know.**

So, as I look at space and as I join you tonight, sure, I think about space exploration as an economic activity of Colorado. But I think about it as more than that. It is something that symbolizes to me that restless spirit in all of us, restless to find out what's out there, to learn what we don't yet know.

Let me turn, because I want to be brief, to the main message I want to share with you.

One of the key questions in space exploration is allocation of resources, because what we want to do to explore the unknown takes a commitment of resources. If I were to test the undercurrent in this whole audience, I'll bet it's asking if we are going to commit the resources to do what ought to be done.

Let's examine that for a moment.

Society has a certain kind of maintenance that it has to cover. You know, it's the food you need, the shelter, the necessities. Beyond that, you take your productivity and you begin to invest.

This society, right now, is being pushed hard and it's in an economic competition worldwide.

In my judgment, if we're really to make a resource allocation to new science, both basic and applied, we have got to have a healthy economy to finance it.

Therefore, as a new Governor, 14, 15 months in office, my principal assignment, I say to myself each day as I go to work, is to help Colorado prepare for its future, but particularly its economic future. We live in an increasingly competitive world. And we, if we're going to compete successfully and have sufficient productivity to invest in research and in exploration, we've got to do two things. One, we've got to get smarter, and two, we've got to work harder.

That comes from a Democrat. It's absolutely the philosophy I bring to my responsibilities.

As I begin to explore what we need to do to be smarter and work harder, I obviously think seriously about how we invest our present resources. We've got to do, both in Colorado and in this nation, in my judgment, the following things. We've got to invest more in the education of our work force. It is the single most important factor in our economy. The economies of the future that are really first-rate are going to be those which do the best job of investing in the work force. The second thing we need to do is to invest in the tools of production. On the private side, that means plant and equipment and other matters. On the public side, it's infrastructure. But to pull off those two investments in education and an infrastructure and in plant and equipment and tools, you've got to find a way to get the resources to do it. I am talking about savings.

One of those critical problems I face in the world economy is the saving rate of this nation as compared to our foreign competition. In Japan and Korea, the savings rate is 15 percent of the gross national product per year. In our nation, our economy, it is four to five percent. I want to focus on that.

I do not think we're going to have resources to adequately explore space unless we increase the saving rate of this nation. It's absolutely critical to our deficit, our balance of trade and our allocation of resources.

How, then, do we together — because I think you are a part of the leadership of this nation, and those of you overseas, I have to include you in this — how do we bring a people to an act of collective will? That's what it takes, an act of collective will that says, "We want to prepare for our future. We're willing to forego some instant gratification, and we're willing to invest in that future very deliberately, with discipline and with strategy." That, I think, is our challenge.

It's a challenge I feel as Governor of Colorado. As I go throughout this state, I have some short-term agendas, but the long-term agenda is this.

Can we bring this nation back to a point of collective will?

We had it in World War II, certainly, collective will that says we have potential that is not yet realized. That potential, if we're going to realize it, demands that we save and invest, particularly in the quality of our work force and in our infrastructure and in our research.

I think we can do that, but that is a challenge to all of us. As I thought about the essential key to motivating this nation to invest sufficiently in space, it is we've got to make our economy healthy. And the key to that as I've just discussed, is collective will.

Now, let me bring this to a conclusion.

As I look at how we obtain a healthy economy and great science, we obviously come back to the question of the quality of our work force.

You in the Space Foundation have done a wonderful job of focusing some of the specialized education and research that we need, and I congratulate you for that. But we still have a nation in which 25 percent of us are functionally illiterate. We're functionally illiterate. We have a nation in which the dropout rate of Hispanics and Blacks in high school reaches 40 to 50 percent, where the dropout rate of all those attending high school reaches nearly 25 percent.

We are, as we approach a society that demands increasing skill to be productive, not keeping pace. If we are to maintain good science and a good economy, we must not train only those who are specialists in an area of excellence, but we've got to bring along that main body of our work force and find a way to make them a productive part of our society.

In simple terms, we can't have that many people riding in the wagon. We've got to have more people pushing the wagon. And when you have a society that is approaching 25 percent functionally unemployable because they're functionally illiterate, we've got a job, a challenge in education that is more than just those challenges related to the upper echelon of science.

We also have a challenge in improving that broad base of education of our citizenry.

The final point I want to make is we obviously need to approach that problem of illiteracy with all the remedial education that we can find, all the rehabilitation of those who have dropped out of being usefully employable.

But in addition, we need to look at the very young. As Governor, as I look at the options, I have returned more and more to what happens to the very young among us in the first five years. Because we need to catch that human potential in those early years, to stimulate children, to motivate them, to give them hope, to say, "I can cope with the system. I can be a productive part of it."

Sometimes, if we wait beyond the fifth or the sixth year of life, we have an increasing multitude who says, "It doesn't work for me, I'm going to ride in the wagon, I'm not going to push it."

So let me close tonight by having those of you who are interested in space think all through the system of education and focus back on what we're doing in this nation in the preschool years.

It is often there that we find that we make that critical distinction to a youngster who's saying, "What kind of a world is this? Is it a world that gives me a chance? Is it a world which has rewards if I put effort in? Is it a world that's going to take whatever temporary handicap I have and correct it now before it gets very expensive to correct?" I think if we do that, in addition to concentrating on the specialty education that you need for science, then we'll have both things.

We'll have those who are skilled to do the exploration that we need to do, and we'll have a work force that will make a healthy economy which will deliver enough productivity and product that it can invest resources in exploration and science.

I think of that in a circular form, because as a government official I know that critical problem of allocation of resources. I want us as a nation to be that cutting edge in society that is pushing that area of new knowledge. We can do it. We can do it, but we need to do it by looking at the whole of our economy and by motivating all of our citizens to be a part of the productive work force.

This nation has potential that has not yet been realized.

My most recent memory in history is what we did in World War II. We were challenged to build liberty ships. We moved the time table of liberty ship construction from 180 days to 16 days.

It's because we had a collective will. We said, "We can do it."

Right now we're again being challenged, not in a military conflict per se, but in an economic challenge. We need to develop a collective will to respond.

Space exploration, space research is a part of it. But it can never happen unless we bring along all of our society to the commitment that, hey, you've got a job to do, you've got a piece of the action that you need to carry. We're going to have the kind of an educational system that permits you to be a full partner in the future of this nation.

Thank you very much.

**MR. MACLEOD:** In working with those teachers, in showing those young children what they can do, you can look at another program that we have; we do not offer a panacea, we don't offer programs that are panaceas, but the program that we offer for teachers called "Getting Comfortable Teaching With Space," using space to excite and motivate, is aimed directly at the non-science teachers, the non-technical person in the schools.

The average teachers, about age 42, didn't have computers when they went to college. They didn't have space when they went to college. Those are the people you need to convince that they can get involved with exciting kids, using high tech, using space to introduce high tech and computers, and that's what we try to do with our programs.

We've had over 200 teachers now go through that program with graduate credit available from the University of Colorado.

Using the best, the positive images of space to turn kids on and hold their attention at an age when that imagination is the most vivid, is fundamental to this effort. It applies equally to minorities, whether they be Black, Hispanic, or anything else, and it applies equally to boys and girls.

Some of the best performers in our summer school programs here over the last three years have been girls, because we tell them when you're in space, it doesn't matter what size you are. It doesn't matter whether you're a boy or a girl. It matters whether you have a disciplined mind and imagination, and if you're persistent, you can do anything. We found space does work as a motivator. We suggest that the students and the teachers approach the subject of space equally ignorant.

Equally ignorant. We all get into it together - it's exciting and it's fun. We used it not to teach space, but to teach the other subjects, using space examples. That what U.S. Space Foundation programs are about.

The next matter we're going to look at is how to get those students' parents — who make up "middle America" — involved in looking to the future, looking to a proud future, not constantly denigrating ourselves as a nation or as a society. As Governor Romer said, how can we get together? How can we recognize what's going on? What benefits do we get from the space program?

We have a brilliant individual with us here tonight who, as an Academy Award-winning producer, came up with the concept, came to the U.S. Space Foundation — and proposed what will be an award-winning television series, pairing unlikely people, to tell you and all of America what benefits space has brought into our lives.

Only five of these spots have been distributed so far. We have 22 of them made, and in the last three weeks or so, a version by Hugh Downs for radio was distributed. They all start, "This is Hugh Downs, speaking for the United States Space Foundation."

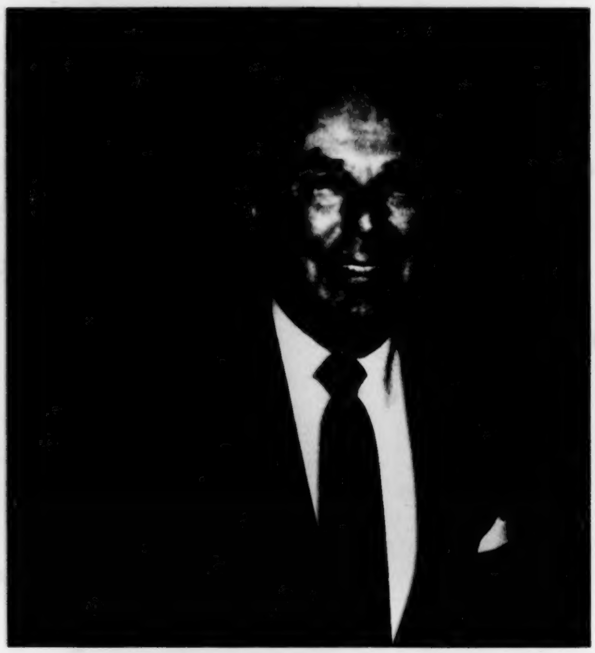
Right now, we will roll that series of TV spots, which the United States Space Foundation sponsored, with Doug Morrow as producer. (We'll introduce Doug in just a minute.) We are convinced these are going to make a major impact on the views and attitudes of American people towards space.

(Video shown.)

**MR. MACLEOD:** Millions of people have already seen these five spots, as they're being shown as public service ads in cooperation with the Advertising Council. We're getting thousands of calls from people who are dialing 800-255-1000. Dial it yourself and see what you get. You will hear a lady's voice asking you for your name and address, thanking you for calling about the space program, and then that computer, because that's what it is, talks to our computer overnight, and we print out each day the names and addresses of the people who have called in. About once a week we have a mailing party - with some of the volunteers present tonight - who come in and stick labels on a brochure produced by NASA that explains more about these space benefits, and where people can get more information about each one of those that have been mentioned in the series.

The Advertising Council tells us that over a 19-month period we'll get about $25 million in free advertising. The investment in that was a lot of time and effort on the part of this one man, to contact the celebrities, convince them that they should pair up, and then convince 19 corporations and foundations, most of them not aerospace, to contribute a little over a million dollars in financing.

All of that came together during the past year, and now I hope you'll welcome with me a gentleman with a tremendous amount of stamina, who at the age of 71, by the way, climbed Mt. Everest to 21,000 feet without oxygen, and has degrees from Columbia and New York in political science, Bachelor of Laws and a Master of Laws, and along the way he became an Academy Award writer/producer. Help me welcome now, Doug Morrow.



*DOUG MORROW, creator/producer of the Public Service Series, "Space Technology... This Is What's In It For You," is an award-winning member of the motion picture and advertising business. He currently serves as a member of the NASA Advisory Council and has been honored both by NASA and the Congress for his contributions to the United States Space Effort. Morrow became involved with the U.S. Space Program after reaching over 21,000 feet on Mount Everest without using oxygen, at age 71. Morrow attended Columbia and New York Universities, and holds a Bachelor's degree in Political Science, a Bachelor of Laws, and a Master of Laws.*

**MR. MORROW:** Thank you very much. I'm going to be very brief tonight, because I was on last night and whatever was on my mind I got off last night. Many of you were there, and I don't want to repeat myself. But there are a couple of observations I would like to make. Dick said something about getting these celebrities together.

It appeared, going in, as if it was an impossible job. Steinem/Heston together? Impossible but it turned out that it wasn't.

Jackson and Goldwater, no problem. Tip O'Neill, Bill Buckley, no problem. And I made rather extended reference last night to the fact that this indicated something to me. As this whole project proceeded, I became convinced that one of the things that we occasionally worry about is, does the American Space Program have a constituency? If you mean an organized constituency with an office on Massachusetts Avenue, no.

**The American people...are expecting us to do what has to be done. They are relying on the experts.**

But I think we have probably a stronger constituency.

The American people...I am convinced of this, and more so since I got involved in this project...are expecting us to do what has to be done. They are relying on the experts.

They don't understand the technicalities. They don't understand the ins and outs of budget appropriations, and the nonsense that goes on in Washington. They know that our future is inextricably tied up with space. As my housekeeper said — I mentioned this last night — she is semi-literate, but a wise woman. "Why are they messing around back there? Where else are they going to go?" There is no choice.

She put the whole historical perspective of this into those two simple sentences. I am now absolutely convinced that the American public is confidently expecting us to do what needs to be done.

That's the good news. We have a hell of a constituency. So the glass is at least half full. But there is always a bad side, and I am going to be ungracious tonight and touch on two things which have been touched on in the last couple of days here.

Jim Fletcher touched on it at lunch today. And, incidentally, I have to tell you that what Dr. Fletcher has done is remarkable. He had headed the agency, as you all know, once before, and then went about his own personal agenda. He didn't want this job. It was a can of worms.

After Challenger, I don't know who would have wanted this job. But when the President asked him to do it, he did; and I think he has performed an incredible public service to this country.

And now, why I think the glass may not be half full. There are two things I want to touch on very briefly.

One, the Challenger accident occurred in January of '86.

It seems to me that the very least we could have expected is that within a short period of time, three months at the most, there should have been... in the nadir of our space program, at the lowest point it's ever been... a powerful incisive, detailed statement of national space policy.

We waited two years.

It is one of the most classic examples...I can think of no other that approaches it... of paralysis by analysis. And during this period Dr. Fletcher was like the Dutch boy on the dike, putting his finger in here and another finger in there, trying to keep this ship afloat. And finally, after two years, we got a very good statement of national space policy. Now, I know that the President is deeply personally committed to the American Space Program. So I just want to pose a question tonight.

What is there in the byzantine White House bureaucracy that held this thing up for two years?

I don't know the answer. And it may occur in subsequent administrations, on whichever side of the aisle they may fall. But I think that we who are concerned and interested and dedicated should do whatever we can to see that we never again get this kind of a delay, particularly at a time when help is so sorely needed.

Now, there's a second thing I would like to mention, and then I'm finished.

I have been watching, for the better part of the year, a gaggle of candidates rushing around the country. I use the phrase gaggle of candidates. I would much prefer to have said a pride of candidates, but I haven't been able to detect a lion among them.

They have been debating for almost a year.

I think I've followed it closely, at least as closely as the average citizen. And in that series of debates, not word one by anybody about the American Space Program. Why? There's a very practical answer to that question. It appears obvious to me that these candidates, on their way around the country, as they approach a town or a community, say to the staff, "Where am I next?" "You're in so and so."

"What is it they want to hear?" And then they concoct what they think the audience wants to hear. For heaven's sake, why can't they address themselves, good or bad, to basic issues and let the chips fall? I have come to the conclusion — and I can't believe I'm going to say this — that if some candidate got up and said, "I'm going to spend a moment or two on the American Space Program, and I want you to know that I'm against it. It would be at the very bottom of my list of priorities. That's how I feel. I think there are other things we can do, and that's not one of them."

I might be inclined to vote for this guy, because at least I would know we've got an honest man in the job. I don't like what he said, but he's been honest. But it is inconceivable to me that, on both sides, there has not been a reference to space. Oh, in Dr. Forman's session the other day and Dr. Fletcher at lunch today mentioned that there had been a few little statements. He was very gracious. I'm not as much of a gentleman as he is. And tell you that all we have gotten are a few ineffectual, obscure 'position papers.' The definition of a position paper is "file and forget." They have simply ducked the issue.

One candidate did make a very mild statement, but where did he make it? In Huntsville, Alabama, where else? He certainly isn't going to go down there and say, "Let's scrap the program." The whole situation is incredible.

This Symposium has been referred to as the World Series of Space. So, by definition, there must be in this room tonight the movers, the shakers and the heavy hitters. And I plead with you... you all have constituencies. You are all the center of concentric circles of people and influences. Move and shake and hit these people, and make them commit themselves, one way or another, on where they stand. It can be done, and I ask the media to do the same thing.

Now, the media is not perfect, but neither am I, and neither are any of you. I guess there are some flakes in the media, but there are flakes everywhere. But by and large, they do an honest job, and if they are as devoted to this country as I know they are, I ask them to hit these candidates until they are forced to make their positions clear. We have a right to know, because we're not at the dawn of the Space Age. The sun has risen. This is not a new frontier. We're there. The Space Age is going to go on whether we're in it or not. It is inescapable. There is no turning back. If we don't do it, somebody else will do it...friend or adversary. We have to be in the forefront of it. And I believe we are entitled to know where those who presume to lead us stand. I ask you all to do whatever you can to force these people to commit and express themselves.

And that's about all I really have to say tonight.

I am delighted that I've had an opportunity to be a part of this. At times I do regret it, because it's consumed my life the last few years. But I am totally committed to the future, not only of this country, but of the people on this planet and, of course, our American people, primarily. This is where our future is.

These spots that we put together are only the first grass-root effort.

We'll hope to follow it up into the future and keep the American public informed and advised as to what we are doing.

I ask all of you to help us as much as you can. I thank you for allowing me to spend a few minutes to get a few thoughts off of my chest. Thank you.

**MR. MACLEOD:** We just presented a certificate of appreciation to Doug for all the work he's done for us, and are delighted that he has agreed to accept a position as a Director of the U.S. Space Foundation.

A lot has happened over the past year as we've just been discussing. In order to make some of that happen, in order to make this particular project happen, a lot of money had to come forward. Our Chairman, Gen. Jim Hill, now will come up and talk to you a bit about that.

**GEN. HILL:** Thank you, Dick. I'm really not going to talk to you much about who provided it. You already heard Dick say that there were 19 companies that the Foundation, with Doug Morrow's help and motivation, persuaded to make the contributions of over a million dollars for the production of these spots that you have seen tonight.

There was, in addition to that, an introduction by all four of the living presidents, which we didn't show in the interest of time. You will be seeing all of them on television, we hope, as time goes by.

I do want to identify the 19 firms that made the contributions to make these spots possible.

The Allied-Signal Foundation, Incorporated; the Atlantic Richfield Company; the Boeing Company; Cambell-Ewald Company; General Foods Corporation; Hilton Hotels Corporation; Lockheed Corporation; McDonnell-Douglas Foundation; Mobile Corporation; Northrop Corporation; Rockwell International Trust; United Technologies Corporation, and there are seven of the firms — I read you twelve names — there are seven of the firms that are represented here tonight.

We did plan to send certificates of appreciation to all firms, but I would like to present personally, to the representatives of the seven firms that made contributions that are here tonight, a certificate to them.

The first presentation is Terry Hart, AT&T Foundation.

When I call your names would you come forward, please.

Mr. Bill Friend,— Bechtel Foundation. There you are, Bill. Thank you.

Kirk Keer, Grumman Corporation.

Clint Hundley, International Business Machines Corporation.

Jerry Zionic, Martin Marietta Corporation.

Richard Bent, TRW Foundation.

Jim Poshusta, United Airlines.

And now I would like to express again our appreciation to all these firms for their contributions and for the support they've given the United States Space Foundation, and for their efforts in space on behalf of our nation.

It is my pleasure now to cap this evening off by introducing to you a man whom I'm sure that you already know.

He's a man which I have certainly revered all my life, and I'm sure that most of you have. There may be some of you in the audience that are young enough that you might not have known all of the accomplishments of this man, and I will read a few things to you about him.

Dr. Edward Teller was born in Budapest and received his university education in Germany, being awarded a Ph.D. from the University of Leipzig in 1930. With the rise of the Nazis, he left Germany and went first to the University of London, and then to the United States where he became a citizen in 1941.

Dr. Teller was a theoretical physicist working in the fields of quantum theory, molecular physics, and astrophysics.

The possibilities of fission, together with the menace of Nazi Germany, led him to work on the Manhattan Project. After World War II Dr. Teller became professor of physics at the University of Chicago.

In 1952 he became consultant at the newly founded Lawrence Livermore Laboratory. In 1954 he was Associate Director, and from 1958 to '60 he was Director of the Laboratory.

In 1960 he became Professor of Physics at large at the University of California, while retaining the position of Associate Director at Livermore.

He retired from these positions in 1975, and has held the positions of Associate Director Emeritus at Livermore, and Senior Research Fellow at the Hoover Institute since then.

Dr. Teller is going to say a few words to us tonight to cap this wonderful evening off, and to give us his views on space activities.

*DR. EDWARD TELLER was born in Budapest and received his university education in Germany, being awarded a Ph.D. from the University of Leipzig in 1930. In the early thirties, he taught and conducted research at Goettingen and in Copenhagen. With the rise of the Nazis, he left Germany and went first to the University of London, and then to the United States, where he became a citizen in 1941. Dr. Teller was a theoretical physicist working in the fields of quantum theory, molecular physics and astrophysics. The possibilities of fission, together with the menace of Nazi Germany, led him to work on the Manhattan Project. After WWII, Dr. Teller became Professor of Physics at the University of Chicago, where he remained until the threat of Soviet technological developments motivated him to return as Assistant Director to Los Alamos Scientific Laboratory. In 1954, he was Associate Director, and from 1958 to 1960, Director. In 1960, he became University Professor of Physics at the University of California while retaining the position of Associate Director at Livermore. He retired from these positions in 1975, and has held the positions of Associate Director Emeritus at Livermore and Senior Research Fellow at the Hoover Institute since then.*

**DR. TELLER:** Thank you very much. I am privileged to be here.

I want to discuss a point that I consider a real problem, but first I want to discuss a point that was raised as to whether men and women can perform equally in space.

I first responded to the question in testimony to the Senate. And I don't agree that the equality is complete. When I was asked whether women should be astronauts, I answered that all astronauts should be women. I was promptly asked why, and I said, "Because they weigh less and have more sense."

Today, my opinion has moved away from that topic in a more radical direction. Men and women in space have performed in a remarkable way. They will continue to be needed, but we should now put the emphasis not on manned space flight, where the requirements are for the highest degree of safety, but on robotics.

After the terrible accident in January of 1986, our space effort came to a practical stop. In the meantime, the Soviet Union forged ahead. It now has become very clear that the Soviet Union is capable of putting into space at least ten times as much material as we are. That is a very important difference.

The immediate uses of space include a number of important items: surveillance of the globe, reporting on weather, crops, accidents, and military developments, the maintenance of communication, and a very particularly important item, for me at least, space experiments.

The first steps in space were accomplished with the direct participation of man. We are rightly proud of our early manned space flight and of the successful manned expeditions to the moon. But that chapter is behind us. The occasional appearance of man in space may be needed to correct mistakes. But the main job can be performed by robots. Indeed, I claim it must be done by robotics.

When we are going to a place like the moon, we don't know what we are going to find there. NO robot would be able to do what needs to be done. Man must be available.

But in the near-term jobs of surveillance, military support, and communications, we know what we shall encounter: we shall find what we have put there. What is needed can be predicted and can be handled by robotics.

It is sometimes claimed that experiments cannot be performed by robots. That is mostly because we are used to doing tasks with our own hands; therefore, we often fail to consider the advantage of doing them the robotic way.

Some great and remarkable research projects are planned: astronomic observations, experiments requiring an excellent vacuum, and experiments exploring the refined details of gravitation. All these can be planned in detail. The alternatives can be foreseen, and robots are adequate for the execution.

**Space has an unlimited number of uses. The most urgent and obvious application may well be defense.**

Robots can be given sensory "organs" both more robust and more refined than human sensory organs. The robot can be given extremely fast reaction times. In experiments performed not too far from the earth, decisions requiring intelligence can be referred to an appropriate earthbound team. The time needed for transmitting signals is negligible.

In such experiments, we should risk money and not lives. Then we would not need to avoid accidents with 100 percent certainty. The result would be a great cost reduction and much faster progress.

Space has an unlimited number of uses. The most urgent and obvious application may well be defense. In this respect, the Soviet Union is far ahead of us, whether we are considering conventional conflict or missile defense.

Whatever is to be done, if it is to be effective, must be able to be done with the most advanced technology. That, as is completely clear and obvious, includes space technology.

An impenetrable space shield will never exist, but space technology will be a necessary component of a good and improving defense. In practically every case, robots in space will be preferable. And, of course, a defensive system will need components not located in space.

In the long view of space activities, men and women will become necessary. They will even become the most important aspect of space exploration. When we go to Mars, when we explore the planetary system, we shall find what we do not expect and cannot even imagine. Even in the lifetimes of many of you, we shall explore our sister planets. In this longer stride, robots will help but not suffice.

**But for the immediate future, we must not hesitate. With the help of robots, we can obtain the most knowledge with the greatest safety, and we can get results at lower expenditures.**

But for the immediate future, we must not hesitate. With the help of robots, we can obtain the most knowledge with the greatest safety, and we can get results at lower expenditures.

It is a particular privilege to talk with a group of people who in these matters will make great contributions to the space program.

Thank you very much.

**GEN. HILL:** Thank you, Dr. Teller, so much, and I want you to know that the Space Foundation is appreciative of your support.

For the audience, Dr. Teller has been and still is one of our Foundation's staunchest supporters. He's been to each one of our Symposia, and he will continue to come, I'm sure. Dr. Teller, we're grateful to you, and we thank you so much for being with us.

Dick, do you have any announcements or anything that you would like to say?

**MR. MACLEOD:** I would like to close tonight, by summarizing something of what you've heard a lot about, from a lot of dedicated people, about classes and courses, both for children and teachers, about really making an effort to use the excitement of space to motivate kids to achieve, not to be satisfied, but to use the role models of real heroes, not sports heroes, not movie stars, **real heroes**, the astronauts; people who put their lives on the line because they believe in what they do.

Those are the heroes we want our children to look up to, and they will. Teachers tell us that in those lower grades the Governor mentioned, that the kids are turned on most by ghosts, dinosaurs and space.

If you want to really get after them, try teaching any subject you want using space examples — and it works. You've heard about the computer space net that we inaugurated on Wednesday with Sidney, Nebraska — a group of very bright kids talking by computer with Astronaut Ox van Hoften, linked over the Hewlett-Packard-donated system. Thirty-eight kids were there, in the fifth or sixth grades, along with 50-some of their parents. And you know what excites me? The **parents** are excited. They tell us that the kids come home and bubble over about this stuff, whereas they very rarely in the past have even talked to their parents about what goes on in school.

Space excites students, and it can excite people again, throughout the country, if we really put our minds to making it happen.

You've seen "Space Technology, This Is What's In It For You," a brilliant series of ads that will capture the imagination of the American people.

We need a greater effort to get you to ask TV and radio stations, wherever you are, to play those spots.

We have a well-defined program with good people running it, good people supporting it, good companies and foundations helping out. If you're not wearing one of these lapel pins, you ought to want to, I hope, after you finish here tonight.

**Space excites students, and it can excite people again, throughout the country, if we really put our minds to making it happen.**

Don't be left out. Don't be one of the ones who later will say, "Boy, I wish I had gotten in on that a few years ago."

Answer the Space Challenge of '88, which is the theme of our conference here; be a part of it. Stop and think to yourself: "Do I really want to be in a nation just less than 12 years from now, going into the 21st Century, known as the **once great United States?** Wondering "why can't we get no respect," as that comedian says. Well, I would suggest to you tonight, we don't have to be the Rodney Dangerfield among the nations of the 21st century.

But it means that you and the companies and the industries you represent have to get behind the efforts of the U.S. Space Foundation, get behind the doers in this business, and really make it happen. Americans have a great way of doing that. We've heard it all night, we've heard it all week, but we can't keep talking to ourselves. We have to get out to middle America and use the programs that are effective in doing that. Be a part of it, join us.

Thank you and good night.

# SPACE LAW AND POLICY FORUM
# THE FUTURE OF SATELLITE TELECOMMUNICATIONS

*Moderator:*
**Professor William B. Wirin**
Webster University

*Speakers:*
**Milton L. Smith**, Esq.
Director of Space Law, Air Force Space Command
**Dr. Ram Jakhu**
Professor, McGill University
**Harold Kimball**
National Telecommunications Information
Administration, U.S. Department of Commerce
**Bruce Kraselsky, Esq.**
Office of Commercial Space Programs
U.S. Department of Commerce

***PROFESSOR WILLIAM B. WIRIN was Command Competition Advocate for the U.S. Air Force Command at Peterson AFB, Colorado. His task was to eliminate unwarranted noncompetitive purchases; and to use the competitive pressures of the open marketplace to find the best technical solution, and to get the needed products and services at a fair and reasonable price. He earned a B.A. in political science from Occidental College, and his Juris Doctor from the University of Southern California School of Law. He was admitted to the Supreme Court of the United States; United States Court of Appeals; Supreme Court, State of California; and the Federal District Court for the Southern District of California. Professor Wirin is currently a Professor at Webster University.***

**PROFESSOR WIRIN**: Maybe by way of introduction I ought to share with you a story that came to me as I thought about the panel today. Some people are concerned about information and others are concerned about statistics.

In that regard I am reminded of the barber in this small town that just had one chair in his shop, and every month or so this man would come in and stick his head in the door and say, "How many waiting?" And the barber would say three or five or eight. And this went on for months, but the man never got a haircut there. The man thought, gee, I wonder where he's getting a haircut. This is a small town. Why does he come in to ask how many are waiting and then leave?

Before the man came in again, the barber said to one of his helpers "Now, when that man comes in, I want you to follow him, I want you to find out where he is getting a haircut."

So, sure enough, about a month later the man came in and he said, "How many waiting?" And the barber said, "Eight."

And the man left and the assistant went after him. The assistant came back about half an hour later and the barber said, "Tell me, where did he go?" And the assistant said, "Well, he went to your house and your wife was entertaining him in the bedroom."

Now, some people would have thought he was asking about statistics. In this instance he was asking about information, and I trust that what we will pass to you today is information and not statistics. Because there is significance, and although sometimes we have to look a little harder to find it, you can be sure that it's there. If we can get the panelists to assemble, I think we will, as the expression is, begin to commence.

The first panel this morning will deal with the question of "The Future of Satellite Telecommunications." Many of you might observe that that would seem to be a rather staid topic. Satellite telecommunications certainly is the primary money-making opportunity in space today. It is a well-developed industry. I would hasten to suggest that, per chance, we are on the verge of a third generation of communication satellites. Even so, the question is, what's the big deal?

In very short scope, if you have followed the industry, you will be aware that fiber optics may well have changed some of the dynamics of the industry.

More than that, there is a concern in the world as to the proper allocation of satellite positions at geosynchronous orbits above the equator.

What we want to explore today is some of the practical problems of telecommunications. We want to explore some of the work that was done at Space WARC, 1985—that's World Administrative Radio Conference.

**Satellite telecommunications certainly is the primary money-making opportunity in space today.**

You get to go into space and broadcast if you have a frequency allocation. It's not a question of an orbital position as much as it is an authorization to talk to and from that place which grants you the opportunity to be there and to make a lucrative return on your investment.

And coming up in the summer of 1988, will be Space WARC '88. You will learn very shortly that the issues that have been discussed these many years have not come to a conclusion and are still being debated.

Again, I would alert you, there are at least three points of view on this issue, and you ought to be attentive as to what those are. Maybe you can suggest solutions, that those who are working the arena have not been able to.

The first panelist that I want to call on is Major Skip Smith. Skip had the misfortune to work for me for some period of time, but he stands apart from other people with a singular accomplishment: he is the first lawyer in the United States Air Force to go to school to get a master's to prepare himself to work in the space law area. He went to McGill University, and with some dialogue between Skip and myself, we concluded that it would be appropriate for him to study and to prepare his master's thesis on the subject of the ITU and the allocation of orbital positions.

After that, he did come to work for me and then participated in the Space WARC 1985. As there is a lack of lawyers who work in this area, and because of his expertise, he became, in effect, the legal advisor to the Ambassador for the United States to the Space WARC.

So I have called upon Skip this morning to give you the background on the issues of what happened in Space WARC '85, and then we will proceed with the other panelists to develop what may well happen this coming year. Skip.

**MAJOR SMITH**: Thank you, Professor.

Picking up on what Professor Wirin mentioned, when he suggested that I do my master's thesis on the Space WARC issues, he said, "And maybe you will get to go to Geneva." And I thought, "Sure." And I did. So it worked out great.

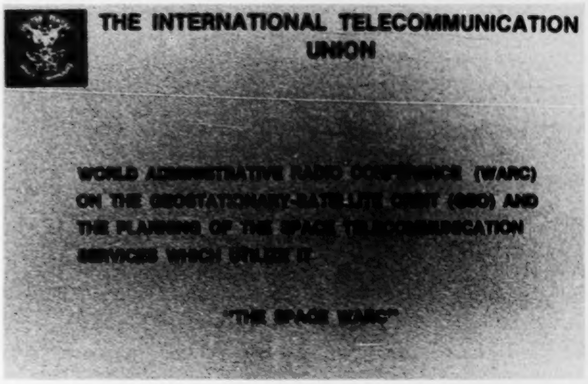
Being the first speaker, I am going to start by violating his first rule. I am going to take more than 10 minutes. I'll probably take more on the order of about 20 minutes.

First of all, let me ask, how many of you have any idea what the Space WARC is? Very few hands there, which is really what I expected. I want to give you the background on the WARC because without it, you wouldn't understand what the rest of the panelists will have to say.

Space telecommunications is the most important commercial use of space and will probably remain that for the foreseeable future. We have billions of dollars of satellites in the geostationary satellite orbit (GSO), that I will be referring to. The Space WARC is possibly the most important space conference, at least of this decade, because it is, in essence, an attempt by the developing countries to change the legal regime applicable to the geostationary satellite orbit for telecommunication satellites, and I will mention a few things about the developing countries.

*MAJOR MILTON "SKIP" SMITH is the Director of Space Law for Air Force Space Command. He has an LL.M. in Space law from the Institute of Air & Space Law, McGill University, where he is also a Doctoral candidate in Space Law. Major Smith attended the 1985 ITU Space Conference as a legal advisor on space law issues for the U.S. delegation. He represents U.S. Space Command on the interagency group preparing U.S. positions for the 1988 ITU Space Conference. Major Smith is a frequent writer and speaker on space law and space arms control issues. He received his law degree from George Washington University and is a graduate of the U.S. Air Force Academy.*

**The Space WARC is possibly the most important space conference, at least of this decade, because it is, in essence, an attempt by the developing countries to change the legal regime applicable to the geostationary satellite orbit for telecommunication satellites**



THE INTERNATIONAL TELECOMMUNICATION UNION

WORLD ADMINISTRATIVE RADIO CONFERENCE (WARC) ON THE GEOSTATIONARY-SATELLITE ORBIT (GSO) AND THE PLANNING OF THE SPACE TELECOMMUNICATION SERVICES WHICH UTILIZE IT

"THE SPACE WARC"

Dr. Jakhu, who is here specifically to tell you about the developing countries, will also speak to you about that. You will find that our views will differ on many occasions, but he happens to be my doctoral advisor, so I have to give him great respect.

**DR. JAKHU**: Thank you.

**MAJOR SMITH**: Up on top you see the long name of this conference. Any conference with a name that long has to have a short name, so we refer to this as the Space WARC, "WARC" for World Administrative Radio Conference.

It is a conference of the International Telecommunications Union, which is the U.N. specialized agency for telecommunications. It's the largest international organization. It now has over 160 countries in the ITU. The conference was called for by developing countries at another ITU World Administrative Radio Conference in 1979. They were concerned about their access in the future to the geostationary satellite orbit. It was to be a two-session conference and the first session was held on the dates you see there in Geneva. 112 nations are represented. The second session will be held this September.

THE INTERNATIONAL TELECOMMUNICATION UNION (ITU)

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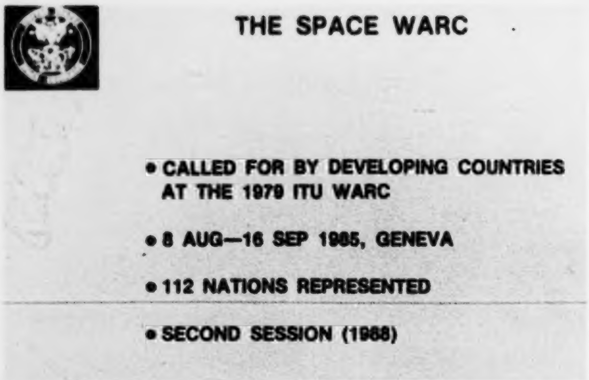


THE SPACE WARC

- CALLED FOR BY DEVELOPING COUNTRIES AT THE 1979 ITU WARC
- 8 AUG—16 SEP 1985, GENEVA
- 112 NATIONS REPRESENTED
- SECOND SESSION (1988)

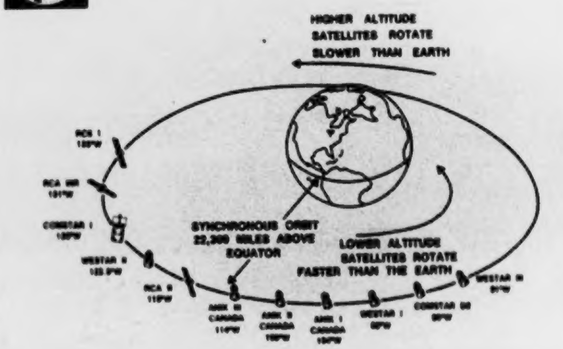
The objective of the Space WARC is to guarantee equitable access for all countries to two things: The geostationary satellite orbit and the radio frequencies used by satellite services in the GSO. Those two things are generally combined.

As Professor Wirin mentioned, it does you no good to have a satellite in the geostationary orbit if you cannot communicate with that satellite via the radio frequency spectrum. When combining these two resources, we refer to this as the orbit/ spectrum resource, and it's important for you to have a general understanding of what the orbit/spectrum resource is and what its limitations are so you see why the developing countries were concerned in the first place.

**The objective of the Space WARC is to guarantee equitable access for all countries to two things: The geostationary satellite orbit and the radio frequencies used by satellite services in the GSO.**

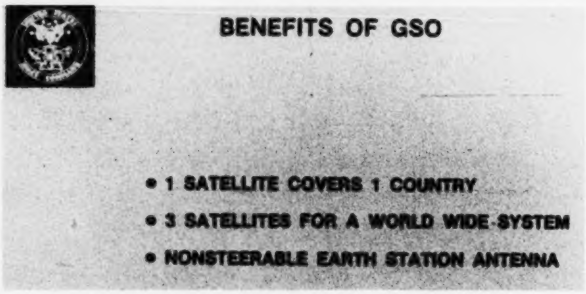
Here we have a depiction of the orbit/spectrum resource.

GEOSTATIONARY SATELLITES



The GSO is 22,300 miles above the equator. It's in equatorial orbit. From that position, satellites are still moving at over 10,000 feet per second but they're moving at the same rate as the earth. They have a 24-hour orbit. Therefore, satellites in the GSO appear to be stationary when viewed from any point on the earth. That's why we can have these cheap earth station antennas in your backyard pointing to a point in space and that satellite seems to sit there. It's moving quite fast, but it's moving at the same rate as the earth. As you see, if satellites were higher or lower than that distance, they would not appear to remain stationary. So there is only one orbit above the earth which will have this particular effect and in which satellites will appear to remain stationary.

That has three very important effects. The first two relate to the space segment. From the geostationary satellite orbit you can see over one-third of the earth's surface; therefore, for domestic communications to just about any one nation you only need one satellite to cover the entire territory continuously of that nation.



BENEFITS OF GSO

- 1 SATELLITE COVERS 1 COUNTRY
- 3 SATELLITES FOR A WORLD WIDE SYSTEM
- NONSTEERABLE EARTH STATION ANTENNA

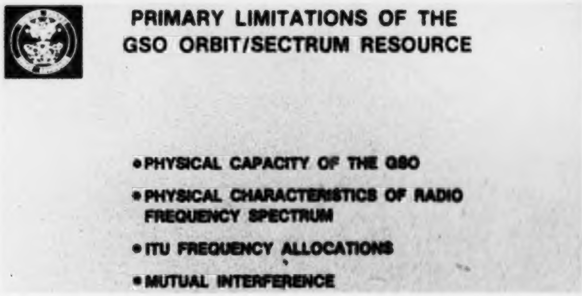
Now, if you want to establish an international system to give you a continuous telecommunications contact throughout the world, you only need three satellites. Thus, you minimize your cost for your space segment.

Now, the third factor deals with your earth station. Because the satellite appears to remain stationary, you do not have to have a steerable earth station, and that minimizes the cost of your earth station. As it turns out, practically all of our telecommunication satellites are in the geostationary satellite orbit because of these benefits.

Now, since we have seen the benefits, what are the limitations? Well, the first is what we have just talked about, the physical capacity of the GSO; mainly, that there is only one GSO. Now, you could put a lot of satellites up there in that orbit without danger of physical collision if it weren't for the other three factors.

The second factor is the physical characteristics of the radio frequency spectrum. As many of you know, some radio frequencies tend to hug the earth. They don't propagate into space. Other frequencies do propagate into space but will not penetrate the ionosphere.

As it turns out, the portion of the radio frequency spectrum that is optimal for use from the GSO lies between one and ten gigahertz. That's a large band, but it also turns out that those same frequencies are optimum for use by other radio communication services, everything from radar to terrestrial microwave services that we have on earth here. So there's a competition amongst the radio communication services for use of this optimum frequency spectrum between one and ten gigahertz.



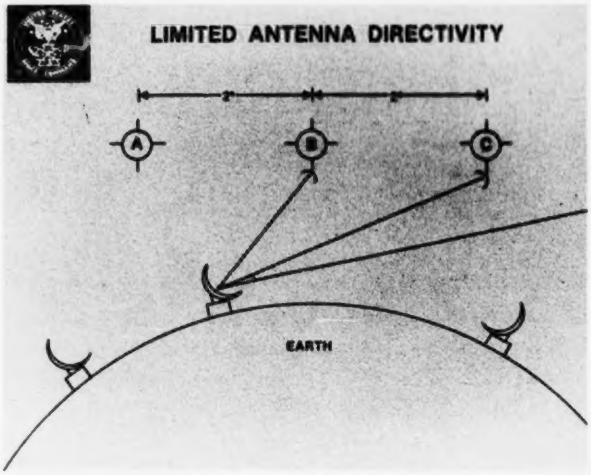
PRIMARY LIMITATIONS OF THE
GSO ORBIT/SECTRUM RESOURCE

- PHYSICAL CAPACITY OF THE GSO
- PHYSICAL CHARACTERISTICS OF RADIO FREQUENCY SPECTRUM
- ITU FREQUENCY ALLOCATIONS
- MUTUAL INTERFERENCE

The ITU, which controls the allocation of frequencies to minimize harmful interference, therefore must allocate frequencies to different services. You would prefer not to have satellites beaming down frequencies to the earth that are the same frequencies being used by radar services on the earth because you would have interference.

So the ITU takes this one to ten gigahertz, which is the optimum, and specifies within that range which frequencies the different services can use and the satellite services which are in the GSO can only use a small portion of those frequencies.

Now, that brings us to the final criteria which is mutual interference. When you have these same frequencies in the commercial sector, commercial satellites within that one to ten gigahertz use what we call the C band. The frequencies aren't that important; just kind of retain this concept of the C band. That is what most commercial satellites use within this optimum range. If they're using the same frequencies, mutual interference can be a problem because of primarily the limited directivity of antennas.


LIMITED ANTENNA DIRECTIVITY

Let's say you had three satellites in the GSO that are all using the C band and you have this earth station that wants to communicate with satellite C and it does so, and it may do so on an intelligent basis. Unfortunately, satellite B, if it is operating on the same C band, may pick up that transmission and it is unwanted. It's what we call interference.

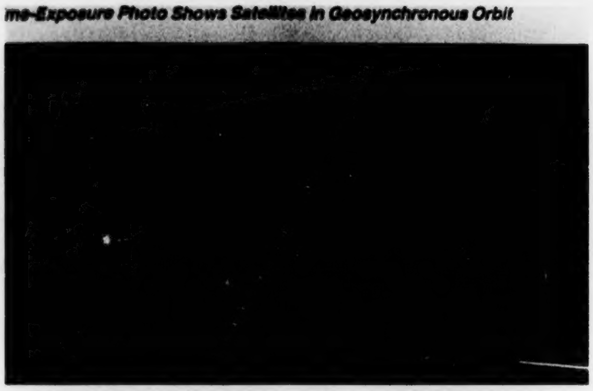
**Satellites that are using the same frequency bands ...must be separated by a minimum separation angle**

Now, you see satellite A, which is separated by four degrees from satellite C on this diagram, is not picking up that interference. Well, in fact, whether satellites A and B would be interfered with would depend on the level of technology which also depends on their cost. But certainly the farther they are separated from satellite C in the GSO, the better off they are because of the limited directivity of antennas.

This brings us to, if I can sum up the consequences of the orbit/spectrum limitations, and this is that satellites that are using the same frequency bands (remember, the bands that you can use are limited), must be separated by a minimum separation angle, the angle you just saw, two degrees, four degrees, maybe five or six degrees, or serve widely separated areas. What I mean by "serving widely separated areas" is two satellites might be located near to each other in the GSO and one could serve Canada and one could serve Brazil. Their antennas, in essence, would be pointed at very different angles and, therefore, even though there is limited antenna directivity, it would be acceptable, and harmful interference would be kept to an acceptable level.

This picture kind of depicts that effect. The lines in this picture are stars. This is time-lapsed photography, and stars, as you know, will over time appear to move across the focal plane of the camera here. The satellites, since they appear to be stationary, remain as a point in space.

***me-Exposure Photo Shows Satellites in Geosynchronous Orbit***



So these are a group of satellites that are separated from each other in the GSO. Some of these satellites are using the C band and some are using higher frequencies up in around the 12 to 15 gigahertz range that can be used, although they're out of the optimum range, they can be used. It's just a little higher technology. There are certain problems with reflection, refraction, and absorption through the earth's atmosphere, but they can be compensated with higher power and better filters and just a little higher technology satellite.

As it turns out, satellites A, C, and E are using the C band. They're all separated by 2.5 degrees in the geostationary orbit. That's hundreds of miles.

Satellites B, D, F, and G are all using the Ku band and they're separated by two degrees.

As it turns out, when the satellites are at higher frequencies, you can get them a little bit closer. So this really illustrates the actual separation we have.

Now, you see satellites E and F, which are close together. They're separated by only .1 degree. As I mentioned, E is a C band satellite, and F is a Ku band satellite, so you don't have the harmful interference problem there.

**There is a problem with the limitations of the orbit/spectrum resource that you can only put so many satellites up for a given level of technology.**

But if they were both C band satellites, could they be located that close to each other? Yes, if they were serving widely separated geographical areas as I explained. If E was serving Canada and F was serving Brazil.

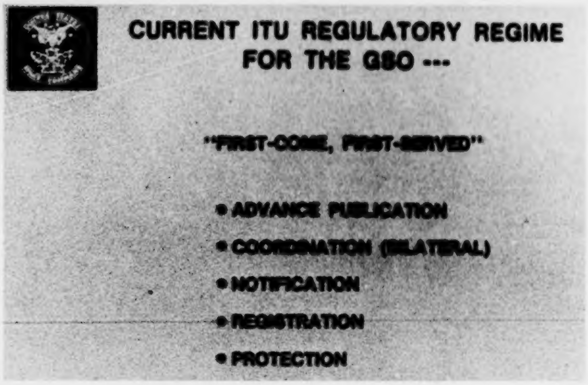
Now, these are all very general rules, but I think you can see that there is a problem with the limitations of the orbit/spectrum resource that you can only put so many satellites up for a given level of technology.

Now, to really understand the concerns of the developing countries you need to understand another thing. This is the regulatory regime of the ITU for satellites in the GSO. It's a four-step procedure which ends in protection.

Now, for any investment, you simply have to have protection. You are not going to get financing to build an apartment building unless you have title to that land, a registered title which will protect your use of that apartment building for the life expectancy of the building itself. You need the same thing for the hundreds of millions of dollars of investment for a satellite telecommunications system. So that's what this system ends in protection.

Regardless of how the system might be changed, you are still going to need a system that grants that protection or you are not going to get the financing for your investment.

We start off with advanced publication done years in advance. It's the general characteristics of the satellite



CURRENT ITU REGULATORY REGIME
FOR THE GSO ---

"FIRST-COME, FIRST-SERVED"

- ADVANCE PUBLICATION
- COORDINATION (BILATERAL)
- NOTIFICATION
- REGISTRATION
- PROTECTION

system you think you want to establish. I think I want to put it at 100 degrees east longitude in the geostationary satellite orbit, I want to use the C band and serve these different geographical areas with certain power levels. That's published by the ITU.

You must coordinate with any countries that you might cause harmful interference to that have a registered system already in the GSO. That's done generally on a bilateral basis.

Now, the country that is already registered and protected does not have to change their system. Maybe they have a satellite system at 98 degrees east longitude which I am going to interfere with and I ask them, "Would you move over one degree to accommodate my system?" They could say, "Yes, I will." And the United States has moved satellites before to accommodate other nations.

But they do not have to say yes and many times they simply won't say yes. Therefore, the country that's seeking to establish a satellite system may have to change their desired characteristic, may have to move to a slightly different orbital location, decrease their power. There's many things you can change, but they have to change.

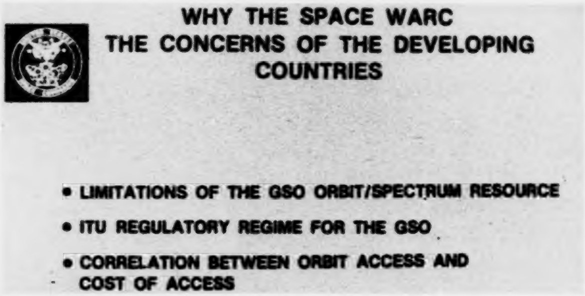
Once you successfully get through the bilateral coordination and, as you can see, that's not really an equal bargaining position type of negotiation, but once that is resolved, you get the notification and then you notify the ITU, based on successful coordination, what your final satellite system characteristics are going to be. That's published again, and then you can register your system with the ITU. Then you are protected against harmful interference from any subsequent system that seeks, through this procedure, to register their satellite system.

**Once you have a system registered, you have a right to replace a dead satellite, in essence, for a perpetual period of time.**

Once you have registered, if they're going to possibly cause harmful interference with you, they must coordinate it with you on a bilateral basis and then you have the power.

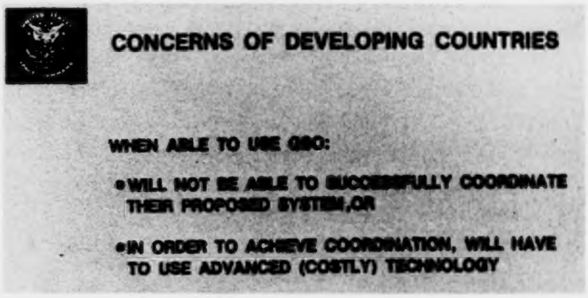
Another aspect of this system that is of concern to developing countries is that it is potentially perpetual. In other words, once you have a system registered, you have a right to replace a dead satellite, in essence, for a perpetual period of time. It would be unlikely you would keep doing that, though, because you would have to replace your satellite with a satellite of the same, or very similar, characteristics in the same GSO location. But you could potentially keep replacing your initially registered system with one of the same or similar characteristics for an indefinite period of time.

Now, in the '70s, the developing countries saw this increasingly intensive use being made of the geostationary orbit. They saw this first-come, first-served regulatory regime and they were concerned about their future access. They saw the limitations in the orbit/spectrum resource, the regulatory regime, and they saw that there was a correlation between orbit access and cost of access. Their concern really boiled down to this, as I see it. When they were able to use the GSO, they would not be able to successfully coordinate their proposed system due to orbit/spectrum crowding, or in order to achieve that coordination they would have to use more advanced, maybe higher frequencies, better filters, better antennas, in all, more costly technology.



WHY THE SPACE WARC
THE CONCERNS OF THE DEVELOPING
COUNTRIES

- LIMITATIONS OF THE GSO ORBIT/SPECTRUM RESOURCE
- ITU REGULATORY REGIME FOR THE GSO
- CORRELATION BETWEEN ORBIT ACCESS AND COST OF ACCESS



CONCERNS OF DEVELOPING COUNTRIES

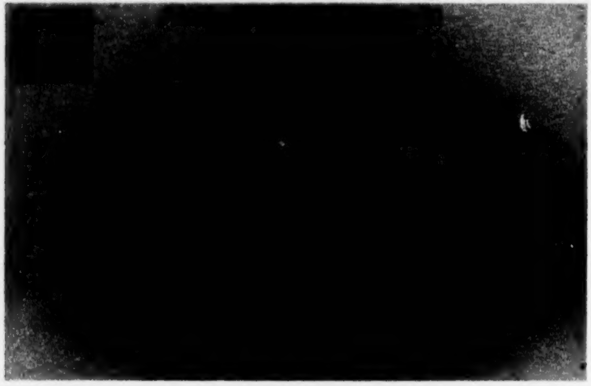
WHEN ABLE TO USE GSO:

- WILL NOT BE ABLE TO SUCCESSFULLY COORDINATE THEIR PROPOSED SYSTEM,OR
- IN ORDER TO ACHIEVE COORDINATION, WILL HAVE TO USE ADVANCED (COSTLY) TECHNOLOGY

Now we get to the Space WARC. What were the issues in 1985? First of all, you start out with which services to plan. There are 17 space services which use the geostationary satellite orbit. These include weather and broadcasting from the GSO.

What the countries are really concerned with was your standard telecommunications satellite which is in what we call the "fixed satellite service", the FSS. Therefore, that first issue was one of the few issues that was resolved reasonably easily and quickly at the '85 session and we generally agreed that we will plan only fixed satellite service.

Now, there are numerous bands that are allocated by the ITU to the fixed satellite service, so they had to decide, well, are we going to plan all of those bands? They have very different characteristics, as you will see in a minute, or are we going to plan just some of them? And then whichever bands we are going to plan, what will be the planning method. So those were general issues.



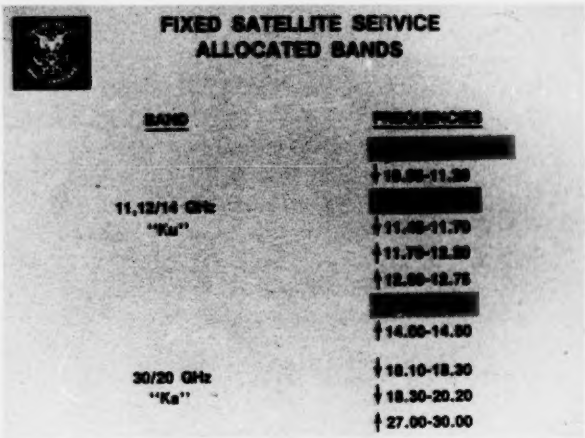
Now you see a lot of numbers up there. Don't worry about the numbers. I just want to give you some general concepts here. You see the C band, which is at 6/4 gigahertz. You see some arrows on the right there next to the frequencies. Those illustrate where the uplinks are to the satellite and the downlinks from the satellite to earth.

You see other frequencies there in the C band, uplinks and downlinks. The areas that are highlighted are what we refer to as the expansion bands. It's an important concept. These bands were newly allocated to the fixed satellite service in 1979. The most important aspect of these bands is that they are not currently in use by the fixed satellite service on a commercial basis. They're not being used. The areas that aren't highlighted, however, are what we call the conventional bands. These frequencies have been used by the fixed satellite service since the '60s, since it was established, in essence, and they are in very heavy use throughout most of the segments of the geostationary satellite orbit. So you have expansion bands and conventional bands. Expansion bands being not used; conventional bands being subject to quite heavy use.

Then you come down and in 7/8 gigahertz band you see another group of frequencies. These are also used reasonably widely throughout the world by government and military systems. They're not used commercially.

Now, getting higher in frequencies, we are above ten gigahertz. We're out of the optimum range, but we're still within the range of the Ku band that is used on a satisfactory basis commercially today. And, again, we have uplinks and downlinks and you have expansion bands and conventional bands.

The area that is highlighted is the expansion bands. Same concept, they're not currently used by the fixed satellite service. The conventional bands are heavily used in some segments of the GSO, particularly those areas serving North America.



FIXED SATELLITE SERVICE
ALLOCATED BANDS

| BAND | FREQUENCIES |
|---|---|
| | [illegible] |
| | ↓ 10.95-11.20 |
| 11,12/14 GHz<br>"Ku" | [illegible] |
| | ↓ 11.45-11.70 |
| | ↑ 11.70-12.20 |
| | ↑ 12.50-12.75 |
| | [illegible] |
| | ↑ 14.00-14.50 |
| 30/20 GHz<br>"Ka" | ↓ 18.10-18.30 |
| | ↓ 18.30-20.20 |
| | ↑ 27.00-30.00 |

You get down to the Ka band, which is even higher frequencies, they are not used on a commercial basis.

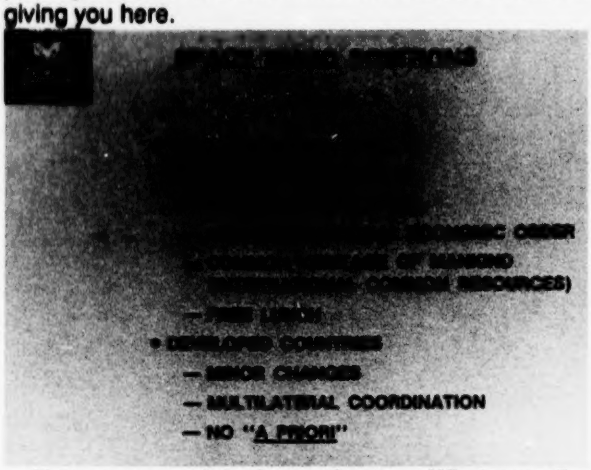
So, you see, there are a lot of different bands here to decide which bands should we plan and very different characteristic of those bands.

**AUDIENCE**: Were there other uses for the expansion bands at the '79 WARC?

**MAJOR SMITH**: Yes, they're used by other terrestrial services.

**AUDIENCE**: What happened to the other terrestrial services?

**MAJOR SMITH**: They're used on what we call a shared basis still. Different services can use the same bands. I'm giving you very general rules because I don't have time to go into specifics. But when they're used on a shared basis, sometimes there's a primary service and a secondary service, and the secondary service can operate as long as they don't cause interference to the primary service. So there's a lot of subrules to what I'm giving you here.



[illegible]

[illegible] ECONOMIC ORDER
[illegible] OF MANKIND
[illegible] COMMON RESOURCES)
— [illegible]
• DEVELOPED COUNTRIES
— MINOR CHANGES
— MULTILATERAL COORDINATION
— NO "A PRIORI"

Now, we came into the conference. What were the positions of the countries starting the conference? This was supposed to be a five-and-a-half week conference, it ended up about six weeks. The developing countries wanted to plan all of the fixed satellite service frequencies, all of them, and they wanted to plan them on an a priori planning method. What **"a priori"** means is "before the fact."

**The developing countries wanted to plan all of the fixed satellite service frequencies, all of them, and they wanted to plan them on an a priori planning method.**

A priori also means before the need, and what the developing countries wanted and, in essence, still want, is to divide up the geostationary satellite orbit, and the radio frequency spectrum and every country in the world, regardless of need, regardless of ability to use, would get an orbital position and radio frequencies associated with that position. In essence, they would theoretically be able to put a satellite up there.

The problem with that is that 90 percent of the developing countries will never have the capacity or need to use a satellite of their own. It may certainly want to use a regional system, and I think a regional satellite system would help every developing country, but they don't have the need, and they never will have that need for a system of their own.

So what's behind this? Well, Dr. Jakhu is going to talk a lot more about this, but this really derives from the new international economic order and the common heritage of mankind concept that we have seen in the Moon Treaty and the 1982 Law of the Sea Convention regarding the mineral resources in the deep seabed under the high seas.

In my view, what these developing countries are looking for, the 90 percent of them that will never need their own satellite, is a free lunch. A free lunch is great if you are the one who is eating, but it can cause you problems if you are the one who is paying for it, and it's costly.

**The equatorial countries are claiming sovereignty over the orbital arcs in the GSO that lie above their countries. They're saying, "Well, the GSO is in equatorial orbit and it's up there 22,300 miles in space; therefore, it's part of our territory."**

What else do I want to say about this? I think your Malis and your Gabons, the countries that are never going to need this, that's what they're doing, they're attempting to receive an economic benefit from something that cost them nothing. That's what I consider the free lunch. The developing countries that will have a need in the future and have a need now, your Indias, Chinas, Brazils, Mexicos, those countries have very real concerns, so although I have developing countries kind of looped together here, it's important to recognize that there really are two groups of developing countries: The smaller group that has valid needs currently or in the foreseeable future and the much larger group that doesn't.

**AUDIENCE**: Weren't there some of the countries — I'm thinking in particular of Equador — who were dealing in space technology, particularly over their territory, as a natural resource which they should have access to regardless of whether or not they intended to use it, but something they could use lease out as a mineral right?

**MAJOR SMITH**: Yes, that's kind of a side issue here, and I was there primarily to help the U.S. delegation with space law issues. That's one of the things I addressed. The equatorial countries are claiming sovereignty over the orbital arcs in the GSO that lie above their countries. They're saying, "Well, the GSO is in equatorial orbit and it's up there 22,300 miles in space; therefore, it's part of our territory."

Their argument goes into a little bit more depth there, but it took up a day or two of discussion in the space WARC, but it's irrelevant to the results and it's really not going anyplace. They have never gotten support from any countries other than equatorial countries, of which there are only eight or nine.

Other developing countries don't criticize them because they're fellow developing countries, but they don't support them, and all the developed countries say that's ridiculous.

**What the developing countries want to do is either rent or sell their allocations to the GSO; or, as you mentioned, trade it for some other benefit.**

**AUDIENCE**: I think it's important to point out that many of the developing countries which have no probability of fielding a satellite are simply establishing a bargaining position by which they may barter that resource for other favors or trade in fact terrestrial communication rights that can be bartered for space communications. So there's no need to partition the value of the space resource, there's no reason to partition that alone.

**MAJOR SMITH**: Sure, that's a good point. I was just about to mention that. Really, what the developing countries want to do is either rent or sell their allocations to the GSO; or, as you mentioned, trade it for some other benefit. So that's what they're looking for. Yes.

**AUDIENCE:** Two questions. One is, has there been a time limit on the protection? When I get access to GSO, is that for the life of the satellite?

**MAJOR SMITH:** That's potentially perpetual. Like I say, you can replace a dead satellite but it has to be replaced by a satellite of the same or very similar characteristics.

**AUDIENCE:** Okay, the second thing is, are you addressing all types of the satellites of GSO?

**MAJOR SMITH:** No, I'm talking about your telecommunication satellites.

**AUDIENCE:** What happens if I want to put a remote sensing satellite?

**MAJOR SMITH:** First of all, probably unless it's a weather satellite it's not going to be in the GSO, and there's other regulatory regimes for different satellite services.

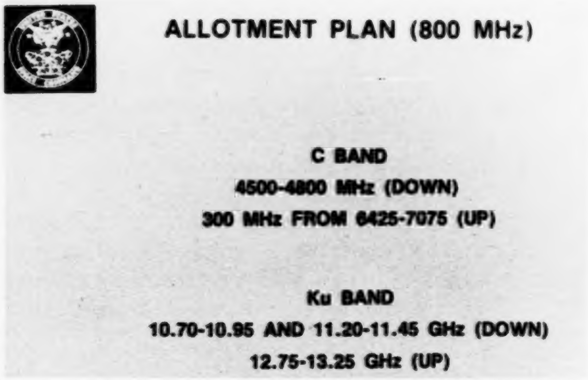
**AUDIENCE:** Where is that process that you now arbitrarily negotiate between those systems?

**MAJOR SMITH:** You know, that's very involved, but I think it's irrelevant to this discussion, because we are looking at the future of telecommunication satellites and I'd prefer to stay on that.

Now, the developed countries, what was their position? Most of them said we will accept some minor changes here. We will accept, for example, multilateral coordination. Let's get countries together. Instead of this bilateral coordination with unequal bargaining power, let's, every number of years, get countries together that need orbit access and work it out on a multilateral basis with possibly some burden-sharing criteria.

For example, maybe when you register your satellite you would recognize at some point in the lifetime of that satellite you might have to move it a half degree or one degree to accommodate somebody else. That's just an example. The bottom line for developed countries is, we don't want an **a priori** system.

Now, what was the result? After long discussion and weeks of no compromise at all, finally a compromise was reached. We have a dual planning method: Allotment plan and improved procedures. Let me tell you what procedures are for the allotment plan. Don't worry about the numbers, these are the expansion bands. The allotment plan is going to be applicable to the expansion bands.

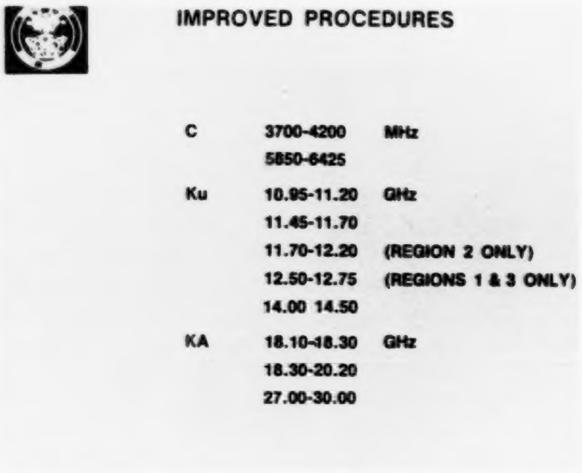


ALLOTMENT PLAN (800 MHz)

C BAND
4500-4800 MHz (DOWN)
300 MHz FROM 6425-7075 (UP)

Ku BAND
10.70-10.95 AND 11.20-11.45 GHz (DOWN)
12.75-13.25 GHz (UP)

The improved procedures are going to be applicable to the conventional bands. When you get down to the KA band, the very high frequencies that aren't even used except on an experimental basis now, they are to be planned at some future conference, hopefully not this conference we are going to have in September. So those are the two planning methods.



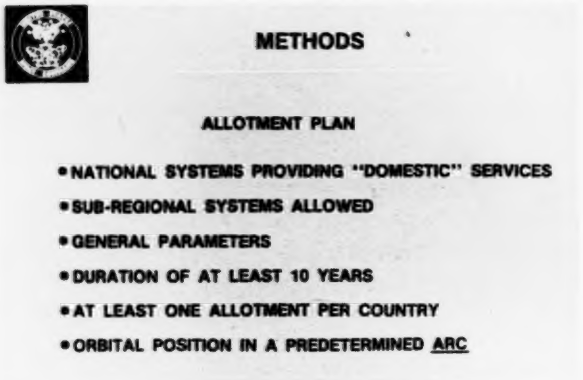
IMPROVED PROCEDURES

| | | |
|---|---|---|
| C | 3700-4200 | MHz |
| | 5850-6425 | |
| Ku | 10.95-11.20 | GHz |
| | 11.45-11.70 | |
| | 11.70-12.20 | (REGION 2 ONLY) |
| | 12.50-12.75 | (REGIONS 1 & 3 ONLY) |
| | 14.00 14.50 | |
| KA | 18.10-18.30 | GHz |
| | 18.30-20.20 | |
| | 27.00-30.00 | |

Now, what are they? What is the allotment plan that's supposed to be applicable to the expansion bands?

Now, Mr. Kimball will be talking about this a lot more later. I just have this slide with some of the phrases. There are no definition of these phrases, but these are the key phrases.

The national system is providing domestic services or what the plan is supposed to be for. It's supposed to allow subregional systems, but we don't exactly know how. It's supposed to be based on general parameters, but we don't know what those parameters are or what their values will be. It is supposed to be of a duration of ten years, but some countries want up to 40 years. It's supposed to allow at least one allotment per country, but some nations want significantly more than one allowed, and it's supposed to be based on an orbital position in a predetermined arc.



METHODS

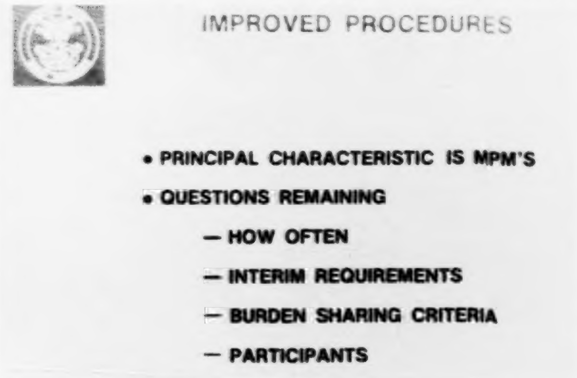
ALLOTMENT PLAN

- NATIONAL SYSTEMS PROVIDING "DOMESTIC" SERVICES
- SUB-REGIONAL SYSTEMS ALLOWED
- GENERAL PARAMETERS
- DURATION OF AT LEAST 10 YEARS
- AT LEAST ONE ALLOTMENT PER COUNTRY
- ORBITAL POSITION IN A PREDETERMINED ARC

There's at least two ways that define this, which, again, Mr. Kimball will talk about, but it could be defined as almost an a priori plan where you concentrate on getting the orbital position now as well as a predetermined arc, or it could be defined in a more flexible way where we say, "Well, we're going to give you an arc and guarantee you that when the need arises, we will give you a imposition within that arc.

**AUDIENCE**: What's an arc? Is it a region that you will fit into eventually?

**MAJOR SMITH**: Yes. Improved procedures? The principal characteristic — this is for the conventional bands and these are the satellite systems that are in use now — the principal characteristic is multilateral planning meetings. But there's a lot of questions to be answered about what that means.



IMPROVED PROCEDURES

- PRINCIPAL CHARACTERISTIC IS MPM'S
- QUESTIONS REMAINING
  - — HOW OFTEN
  - — INTERIM REQUIREMENTS
  - — BURDEN SHARING CRITERIA
  - — PARTICIPANTS

How often will they be? How will interim requirements be satisfied? What will the burden-sharing criteria be? And who will be the participants?

That closes my briefing, and if you have some more questions, I will take them, or maybe it would be better to hold them until after we have all gone. Yes.

**AUDIENCE**: Let me just ask one final question. Usually with remote sensing (unintelligible), hundreds of megahertz that I deal with in situations. Is there a WARC process that does that also?

**MAJOR SMITH**: Not the WARC.

**MR. KIMBALL**: Remote sensing is conducted in a different service than the services that Skip has been talking about, that is, the fixed satellite services. They operate in a different part of the frequency spectrum. Anyone who would propose to operate a remote sensing satellite in the GSO, that had active transmitters, would go through the same process of coordination within the ITU but in different frequency bands.

If it turns out to be a geostationary satellite system, it can still work comfortably on the same orbit because it's in a different frequency band than Skip is showing you. Even satellites in the same service and different frequencies can get close to each other.

**MAJOR SMITH:** Since I took more than my allotted time, unless it's a real pressing question, I think maybe it would be better to move on to the other speakers. We can come back to it. Like I said, I think it's important to have a general understanding of what the Space WARC is and that's what I've tried to give you. If you don't understand some of the points I mentioned earlier, go ahead and ask a question.

**AUDIENCE:** How does the WARC deal with the competing needs of the various national military services? It seems to me that it's fine for commercial and civil purposes, but where a nation of military services feels a need for a communication satellite to keep in contact with their overseas troops or their ships or whatever they have, then there would be a real point of conflict there, because they're not going to want to accede their rights to that communications capability to another nation.

**PROFESSOR WIRIN:** I will let Mr. Kimball answer it.

**MR. KIMBALL**: Well, in the case of the U.S. when we are working with our allies on using the spectrum, we do a lot of coordination through special agreements as, for example, with NATO.

Skip noted the importance of the 7/8 gigahertz band. It's a band commonly used by us and NATO and, in fact, the Soviets. It is more-or-less understood around the world that it is a military use band.

This aspect doesn't arise in the context of the ITU because the ITU doesn't recognize the difference between commercial and military use of the spectrum. So that aspect has to be worked out on the side.

**PROFESSOR WIRIN**: Let me maybe make two comments to bring a little focus here. We're now talking about U.S. application to ITU, the International Telegraphic Union.

Within the United States, of course, the FCC regulates, so you first look to the FCC to qualify for something which the ITU has given to the United States. So it is that filtering process.

Yes.

**AUDIENCE**: Yes, if I obtain protection under this system, if someone infringes upon the rights that I have to be protected, what sanctions do I have available in enforcement?

**MAJOR SMITH**: It's like any other international law, sanctions are difficult to enforce.

There's a Rule — Hal probably knows the number — that says you are supposed to discontinue your service if you are causing harmful interference, and because every country really—if you don't have cooperation, it's going to be just a mess.

So we have had pretty good cooperation, but there have been countries that have just gone ahead and put up satellites even if they didn't get successful coordination.

**MR. KIMBALL**: The U.S., in fact.

**PROFESSOR WIRIN**: Let me make one more observation now with regard to the different legal principles involved here. You have to appreciate that in the United States, we come out of a common-law background which tends to approach legal questions on an as-needed basis.

Under U.S. or English law, our lawyers tended to solve problems as they come up and say, "That's not a real issue yet. I'm not going to decide it." That's what a judge will tell you.

Whereas, if you come up out of a civil law system, they have a concept that all of the issues ought to be

**Within the United States, of course, the FCC regulates, so you first look to the FCC to qualify for something which the ITU has given to the United States.**

decided at the beginning so the people will know exactly what the law is for now and evermore. This a priori versus non-**a priori** concept of how you ought to resolve the issue causes friction.

Having said that, I think that Dr. Ram Jakhu has already been introduced, but let me just hasten to add, this is the man that puts it together and is a doctoral advisor to Skip. He's a good friend of mine and I trust he will be a good friend of yours. I read his thesis on this subject, and while I would come to different conclusions than he would, the strength of his arguments and the manner of his presentation worried me a good bit.

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Dr. Ram Jakhu.

**DR. JAKHU:** Thank you very much.

Actually, I should thank you, Mr. Smith. As a good student, he has done my work and done well.

In order to fully understand the views of the Third World countries, I believe it's imperative to have a look at their background. Therefore, I shall briefly review the policies of the developing countries with respect to general international relations and, particularly, international telecommunication affairs.

Then I shall discuss Third World views on some aspects of the '88 Space WARC, whose decisions, I believe, will have an enormous influence on the operation of satellite telecommunications during the rest of the century and beyond.

The term "Third World" is understood and used synonymously with the developing countries, less developed countries, underdeveloped countries, or the South. These countries greatly differ from one another not only because of their history and political, social, economic and cultural systems but also because of their divergent foreign policies and national priorities. However, they are all underdeveloped and financially poor in comparison with the developed countries. Historically, almost all the developing countries were once colonized countries; the developed countries were invariably the colonizing powers. The colonizing process and economic exploitation have been the primary causes for the underdevelopment of the Third World countries. They still suffer from international trade practices and laws which were established by and still favor the developed countries.

**There is one fact that is not questionable, at least almost all of the present international law has been formulated by, and in response to, the requirements of the developed countries.**

There is one fact that is not questionable, at least almost all of the present international law has been formulated by, and in response to, the requirements of the developed countries. On the other hand, because the developing countries were previously considered as the objects of international law, they did not participate in its development. Thus, the international legal system does not protect their interests.

After gaining their political independence, the "new" states of Asia and Africa started joining the U.N. system and its specialized agencies in order to participate in international affairs as full members of the community of nations. These "new" states, together with other developing countries, formed a numerical majority in the U.N. system for the first time in 1960. Recognizing the role of international law as a means to achieve their developmental goals, they started their efforts for the revision and improvement of international law to meet the needs of the international community of which they now form an absolute majority.

They have acted together in international negotiations in the Third U.N. Conference on the Law of the Sea, and other forums such as the U.N., United Nations Conference on Trade and Development, UNESCO, and ITU. Their efforts and concerns have been mainly directed at establishing a New International Economic

Order. They have been not only asserting their sovereign equality with the developed countries but also demanding **de jure** preferential treatment in international developmental matters. Such demands stem from the fact that they are economically underdeveloped and need exceptional measures to overcome this state of affairs.

The developing countries have not been fully successful in their endeavors because they are mainly new players in international arenas and lack technical expertise and financial resources. In spite of some steps in the right direction, the economic gap between the developing and developed countries has been rapidly expanding.

**Their efforts and concerns have been mainly directed at establishing a New International Economic Order....demanding de jure preferential treatment in international developmental matters. Such demands stem from the fact that they are economically underdeveloped and need exceptional measures to overcome this state of affairs.**

The developing countries have become distrustful of and disappointed with the attitude of the developed countries toward developmental problems of the Third World. Hence, they have actively embarked upon the road to self-help.

On the international level, they are demanding transfer of technology from developed countries and equitable sharing of international natural resources of the seabed and outer space.

Numerous international and national expert studies have addressed that telecommunications are essential to the economic development in the Third World. However, telecommunications facilities in the developing countries are in a pathetic state. Moreover, there is an immense disparity in the extent and quality of telecommunication services between the developed and developing countries.

**On the international level, they are demanding transfer of technology from developed countries and equitable sharing of international natural resources of the seabed and outer space.**

Two-thirds of the world population, mainly in the developing countries, have no access to telephone services. There are now more telephones in Tokyo alone than in the whole of the African continent.

There are various historical and economic reasons for this disparity. However, one of these reasons is that a major portion of the usable radio frequencies has historically been monopolized by the developed countries and is not available for use by the developing countries. It is estimated that only 10 percent of the usable spectrum is being used by 90 percent of the world population, which is located mainly in the Third World. This situation has arisen primarily because of the practice of first-come, first-served with respect to the international sharing of radio frequencies. This practice has been incorporated in the ITU legal instruments long before a majority of the developing countries became full members of the community of nations. Undoubtedly, this practice is against the interests of the Third World.

Since the early '60s, when they got a numerical majority in the U.N. system, the developing countries have become more active in the ITU. They have attempted to improve and democratize the functioning of this international body, and to effect an equitable sharing of the radio frequencies. These efforts are directed primarily at the establishment of a New World Information and Communication Order. By implementing this order, these countries want to increase the development of their telecommunications services and to rectify the imbalances in international communications and information flows.

**The exploration or exploitation of outer space was perceived to promise unprecedented economic benefits for the poor countries of the Third World.**

A new communication order, in their view, is part and parcel of their efforts to establish a New International Economic Order.

The Third World countries have been relatively more successful in the democratization and improvement of functioning of the ITU. However, their efforts to establish equitable sharing of radio frequencies have been confronted more vigorously by the developed countries. Thus, only minor improvements have been made to the status quo, that is, the first-come, first-served practice.

The exploration or exploitation of outer space was perceived to promise unprecedented economic benefits for the poor countries of the Third World. Therefore, these countries, from the very beginning, began to play an active role in the formulation and development of international law to regulate outer space activities. In spite of their technological backwardness, the developing countries were successful in getting some important legal principles incorporated in the 1967 Outer Space Treaty in order to protect and enhance their interests.

One of these principles specified in Article I, paragraph 1, of this Treaty, provides that the use of outer space must be carried out for the benefit and in the interests of all countries irrespective of the degree of their economic or scientific development. The legislative history of this provision clearly shows that the placement of this principle in the legally binding operative part, rather than repeating it in the preamble, was an intentional and concerted action of the developing countries in order to safeguard their future interests in the exploitation of outer space.

**All countries have equal rights to equitable access to and use of the geostationary orbit. Now, "equal rights" specifies the quality of the right and equitable access" refers to the quantity of that right.**

This and other provisions of the Outer Space Treaty are applicable to the use of the geostationary orbit which, in my view, is an integral part of the outer space. Even a cursory reading of these principles show the following: First, the geostationary orbit (GSO) must be utilized for the benefit and in the interests of all countries; the freedom of use of this orbit is a right of all states without discrimination of any kind; such freedom is not unlimited and is to be exercised with due regard to the corresponding interests of other states without infringing their rights; and, finally, the geostationary orbit must not be appropriated by any means whatsoever.

The 1982 Plenipotentiary Conference of the ITU, which is the supreme organ of the ITU, revised Article 33, paragraph 2, of its Convention and added another directive principle for the use of the GSO. As a result, all countries have equal rights to equitable access to and use of the geostationary orbit. Now, "equal rights" specifies the quality of the right and equitable access" refers to the quantity of that right.

Moreover, the new Article incorporated the principle of preferential treatment for the Third World countries as it specifies that in the use of the frequency/orbit resource, the special needs of the developing countries and the geographical situation of particular countries must be taken into account. These principles are not self-executing and lack the precision required of the legal rules to be effectively applicable. Therefore, the ITU is obliged to take necessary steps to develop further the legal regime in the form of Radio Regulations in order to implement these principles.

Looking at the factual situation, in a quarter of a century, the GSO, which was once considered to be an unlimited resource, has begun to show signs of crowding and scarcity, since the availability of radio frequencies for its use is limited by technological and regulatory factors and practices.

The traditional practice of first come and first served for the acquisition of rights to the use of radio frequencies has been extended to the acquisition of geostationary orbital slots. As a result, nearly 85 percent of the geostationary orbital positions have been taken up by a few developed countries.

The developing countries have had less success in using the GSO. Even Indonesia and India, the first developing countries to utilize the orbit, have all experienced undue difficulties in obtaining access to this natural resource. Other Third World countries fear, as Skip mentioned, fear that there may not be any appropriate radio frequencies and orbital positions in the GSO left for them when they are ready to use them.

A **de facto** monopoly by the developed countries in exploitation of the orbit compelled some equatorial countries to declare, in their Bogota Declaration, **de jure** sovereignty over certain portions of the orbit directly above their territories. Although the status of this orbit remains unchanged — what I mean to say is, these claims are legally invalid — the Bogota Declaration highlighted that the Third World countries are dissatisfied with the traditional practice of first come, first served.

**Nearly 85 percent of the geostationary orbital positions have been taken up by a few developed countries.**

Even two decades after the first ITU conference on space telecommunications, the ITU regulatory regime does not safeguard effectively the interests of the developing countries. In view of the distrust of the developed countries which has arisen subsequently, the developing countries have become more active in their attempts to protect their own interests. This tendency has resulted in the developing countries placing greater emphasis on **a priori** rigid, long-term planning in order to do away with the practice of first come, first served.

India, having faced undue difficulties in obtaining access to the orbit, spearheaded efforts to change the legal rules governing this international scarce natural resource. At the 1979 WARC, India, with the support of other Third World countries, actively promoted the adoption of Resolution No. 3 to the effect that a special WARC should be convened in order to guarantee in practice equitable access by all countries to the spectrum/orbit resource.

The proposed space WARC was to be convened in two sessions, as we have mentioned about the '85 and '88 sessions. The first session, held in '85, decided to plan certain frequency bands. The second session the '88 WARC is required to draft a detailed regulatory regime in the form of Radio Regulations in order to implement the decisions of the '85 WARC. It is now accepted that some form of planning has to be drafted at the '88 WARC. But there are certain countries and individuals, who still question the very concept of planning.

In my paper which was distributed this morning, I have enumerated a number of arguments in favor of planning, or I would say against the practice of first come, first served. Thus, I will briefly discuss one or two points here.

The history of ITU clearly shows that planning has been the most acceptable and effective means for equitable distribution of radio frequencies, especially in the congested regions or in the congested bands. Therefore, planning is a necessary tool for the developed countries of Europe and North America if they want to have assured access to the limited frequency bands and orbital positions.

**The present practice of first come, first served is contrary to the earlier mentioned legally binding directive principles. This practice results in benefits accruing to only a handful of states, creates monopolies by the first users and infringes on the rights of others and imposes limitations on the latecomers and encourages appropriation.**

Moreover, from an international legal point of view, the present practice of first come, first served is contrary to the earlier mentioned legally binding directive principles. This practice results in benefits accruing to only a handful of states, creates monopolies by the first users and infringes on the rights of others and imposes limitations on the latecomers and encourages appropriation.

International legal principles have clearly established the inclusive interest of the international community in the exploitation of this resource, while the ITU regulatory regime has developed independently of these principles and favors exclusive claims in such exploitation.

At the '88 Conference, I believe that the Third World countries are going to pursue their policies more or less in the same fashion that they did it before 1988. There are certain issues which I think are going to be controversial, so I will explain the views of the Third World on those issues.

The developing countries are expected to insist on maximum duration of an allotment plan because frequent planning conferences will be a heavy burden on their meager financial resources.

There are different definitions of a "predetermined arc," (as Skip mentioned before,) for the purposes of an allotment plan. The Third World countries will be insisting on specifically designated orbital positions which could be converted into assignments without going through a coordination process.

**The developing countries are expected to insist on maximum duration of an allotment plan**

Perhaps the most controversial issue at the '88 WARC will be that of efficient use of the orbit. The developed countries insist that there is a need to exploit this scarce resource to a maximum advantage. This can be achieved in their views with the use of most advanced and latest technology. The developing countries, on the other hand, advocate the use of an appropriate technology. An appropriate technology (for a country) is that which makes optimum use of existing human material and financial resources. The philosophy behind this is that the developing countries want to ensure not only equitable access but equitable use of the spectrum. For telecommunication needs of the Third World, the latest technology is not always the best solution.

The reason for insistence on the use of appropriate technology is obvious. Such technology will be cheaper to buy from foreign countries and could also be developed by the Third World countries themselves. The developing countries do not want to remain permanent markets for transnational suppliers of satellite technology and services.

**Since 1979, the attitudes of both developed and developing countries seem to be changing towards better understanding of the concerns of each other.**

To rush to the conclusion, I will say that the demands of the developing countries in the past have been for rigid long-term planning covering all frequency bands. But this position was, no doubt, due to the indifference shown by the developed countries toward the needs of these developing countries. However, since 1979, the attitudes of both developed and developing countries seem to be changing towards better understanding of the concerns of each other. Therefore, at the forthcoming '88 WARC, there is every likelihood of reaching an agreement which will effect an equitable sharing of this international resource. So I am very optimistic about '88 WARC.

Thank you.

**PROFESSOR WIRIN**: Any questions?

**AUDIENCE:** In the past, I understood that the developing nations tend to vote as a block to increase their leverage. Inasmuch as you have said that you see a change in the general order of agreement or understanding evolving between the developed nations and the lesser developed nations, do you see the block voting of the developing nations, being dissolved, or how do you see the balance of power changing?

**DR. JAKHU:** Well, as I said, the developing countries differ enormously from one another, so their interests in the future I think are going to be quite different from what they have been before. Some newly industrializing countries, like India, Brazil, Mexico, are space powers and the rest of the developing countries like Belize or Morocco and other countries may not be. So I think there will be some sort of difference of opinion. But for the sake of solidarity, they may tend to vote in blocks.

But that sort of blocks voting is a very slippery process. But I must say that they learn that only from the developed countries because before going to any conference the developed countries carry discussions under the banner of OECD meetings. One is reminded of an old phrase, that is, when an old cock crows, the younger one learns.

**PROFESSOR WIRIN**: Could I make an observation and have you comment? I would suggest that at such conferences, you have people representing different kinds of philosophy. From the Third World, you may tend to have those people who are politicians or professional representatives of their country; whereas, from the developed nations you may tend to have electrical engineers who are experts in the field of telecommunications and I would suggest there is sometimes a disconnect when those two groups start to talk to each other and you might want to comment on that.

**DR. JAKHU:** Obviously, I don't agree with that.

I think that the term calling ITU as a technical body does not make any sense to me. What is a technical body? According to the ITU Convention, this is the organization of sovereign states, established to deal with the interaction of policies relating to the means of telecommunications, regulating them and other related technical activities.

As you know, behind every technical activity, there are other factors involved in that.

To give you one example, why the Soviet Union was not invited to the Washington Conference in 1927, it was obviously, because of political reasons. And why they end up having the Soviet Union in Cairo in 1936, because they could not go ahead with the effective operation of the radio broadcasting services without the cooperation of the Soviet Union. What I'm saying here is that to understand telecommunications to be solely technical actively and expecting ITU just to confine to that aspect, does not make any sense to me.

In 1963, the U.S. was the first country to carry lawyers and politicians as a part of its delegation to the ITU. I don't see anything wrong with that. If you want to protect your interests, you've got to say something about the policy that you want to change, especially if you want to change the rules of the game.

**PROFESSOR WIRIN**: I must take one comment from the gentleman in the rear because he is one of our supreme experts. Mr. Jasentuliyana from the United Nations.

**AUDIENCE**: Thank you very much. I just want to say something perhaps before those two gentlemen speak and also respond to something that Dr. Jakhu spoke to on the question of developing countries, saying they need slots or why they are taking that position.

I think this relates to this question that you discussed. In the developing countries, we are now coming to the people, but all along, most of the developing countries did not have the technical expertise and they do not still have the technical experience to deal with the very complicated, complex negotiations, which these negotiations are.

**Most of the developing countries did not have the technical expertise and they do not still have the technical experience to deal with the very complicated, complex negotiations**

The western countries, for instance, should not be criticized; I mean, I wish all countries would do this. Before they go to the conference, they have coordinated their positions with the other countries and hundreds of computers have calculated various possibilities of different slots and different combinations in the GSO and how these things could be managed.

And then you have these countries with delegations of sometimes 100 arriving there and waiting for six weeks. You also have some delegations coming with two people if you are lucky, sometimes one, and with very little technical background. They are technical, sometimes telecommunications engineers, but with very little background and with no tools at all.

The western countries have the computers and everything set up in Geneva and these people are supposed to make quick positions on this work.

So, naturally, there are two things happening. What you don't understand, you don't give up. So you say each country should have slots. Everybody should have their slots, and we don't want to give up anything that we may use in 10 years, 20 years, or 100 years. One reason is because I do not understand.

Now, if I did understand, I would have certainly cooperated to a great extent because I would see how these things could be managed.

But, on the other hand, you have me and with all these people overwhelming me, with all these technical parameters, and then what I do? I join a whole lot of people that I think have common interests with, Upper Volta, Kenya, and so forth, and work with them because I do not understand. That's block voting. It is purely because of this technical gap in the delegations. I think this is where the other countries have taken steps to remedy this over the last few years by having a lot of training programs, new placement training programs.

ITU itself has been asked to set these things up. So the situation is improving. However, I want to extend these two aspects of block voting by developing countries, and not giving up certain slots in the context of not having enough technical people in their delegations and in the countries.

**PROFESSOR WIRIN:** Some soft rocks have been thrown at the man I want to call on next. I think it's only right that we give Harold Kimball a chance. He is the man who is charged with coordinating and bringing together the U.S. effort to represent the United States this coming summer, and so we will ask you the very simple question, how are you going to do that?

*HAROLD KIMBALL is Science and Technology Policy Advisor at the National Telecommunications and Information Administration (NTIA) of the Department of Commerce. He was appointed to that position from the Bureau of International Communications and Information Policy at the Department of State. At State, Kimball was the Executive Director and a Vice Chairman of the United States delegation to the World Administrative Radio Conference on the Utilization of the Geostationary Satellite Orbit. Prior to that assignment, Kimball was the Director of the Communications and Data Systems Division at NASA Headquarters for more than five years. He has also held technical management positions in the Department of Commerce, the Executive Office of the President, the IIT Research Institute and the Department of the Air Force. Since 1982, Mr. Kimball has been the Vice-Chairman of Study Group 2 of the CCIR (International Radio Consultative Committee) of the ITU. Mr. Kimball began his professional career as an Officer in the USAF. He received a MSEE degree from the University of Illinois and a BSEE from Wayne State University.*

**MR. KIMBALL:** When thinking about how I was going to start my remarks, I was going to say that I thought this topic was rather mundane for this conference where we are dealing with so much sophisticated high-tech software and hardware. But Major Smith's very enthusiastic presentation on the background of what we are involved in has made me see that it is not such a mundane subject for this conference.

The previous speaker has started my adrenalin running a little because his comments remind me of the last two days of the first session when we were still trying to make decisions, having lost a quorum in the conference, two days overtime on the schedule, still debating issues and not finding block voting going on any longer.

I think it's dangerous to characterize the views of the developing countries as consistent across their entire membership because I don't think that's the case in the ITU. It doesn't matter whether the representatives from these countries are politicians or lawyers or engineers, they are really looking out for the interests of their own country.

I think the comments made in the back of the room are quite on the mark. They're looking out for their interest and they will get together with groups to vote when they don't understand what the issues are. But it was not my experience that we were voting 107 to 5 or something like that with 112 countries or so in that first session. The voting was not split that way. Even though, the ITU is a one-country, one-vote organization and the developed countries are always in the minority in these meetings, voting results usually reflect the interests of the countries.

**I think it's dangerous to characterize the views of the developing countries as consistent across their entire membership because I don't think that's the case in the ITU.**

I have been to the plenipotentiary conference in '82 which was very much a political conference; I have been to several administrative radio conferences which are mixed; I've been to the CCIR meetings which are very technical, and the delegates from both developed countries and developing countries, are usually representing their own country's interest.

**The main thing decided at the first session was to do planning in two different regimes: One called allotment planning and one called improved procedures.**

I want to come back now to how we are doing in getting ready for this session. I am just going to dwell on two points of the agenda. Skip pointed out the main thing decided at the first session was to do planning in two different regimes: One called allotment planning and one called improved procedures. The improved procedures also has acronymn associated with it MPM, for multilateral planning meetings.

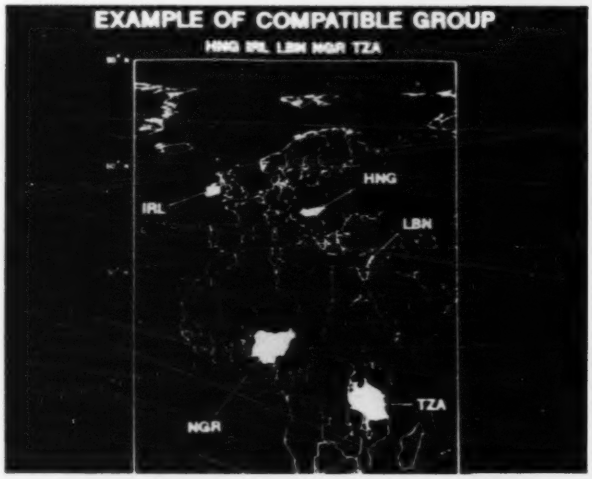
The U.S. proposed the idea of multilateral planning meetings to the first session as an alternative to a prior planning. At the end of that session we were still lumbered with what is not exactly a prior planning but something similar called allotment planning. In addition, the multilateral planning concept was embraced by some developing countries, particularly China and India, who saw it as a second way of guaranteeing access to the geostationary orbit.

What we have now, as a result of the first session, is something that the United States has found a bit disagreeable as we have examined the implications during the last three years.

We have both allotment planning, which we didn't want, and multilateral planning meetings. But the MPM's were defined by the first session in a way which we didn't conceive in our original proposal. So we have been trying to look at how to deal with this situation in this next session.

Let's take the allotment planning issue first. We want to see that resource, used in as flexible a way as possible. The 800 megahertz of the radio spectrum which has been set aside for this is a very valuable resource, and if it is planned in a very rigid way, such as had been done in the past for the broadcast satellite service, it will effectively make that resource unusable.

The rigidity of the broadcasting satellite plan of 1977 has resulted in almost no implementation of broadcast satellite systems in the plan. Here we are in 1988 working with a plan in Europe, Africa and Asia that is almost 15 years old in terms of the technology on which it is based. So there is a plan that doesn't even reflect the kind of technology you have seen discussed this week and we don't want that.



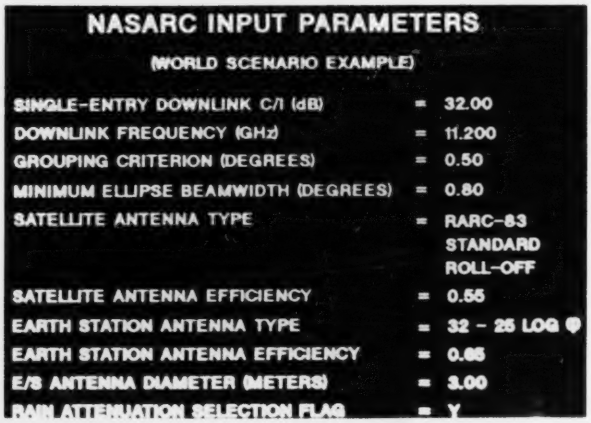
**Let's take the allotment planning issue first. We want to see that resource, used in as flexible a way as possible.**

We managed to get language put into the first-session report which talked about the concept of predetermined arc. We believe that in the allotment planning process, the entries in that plan should be on the basis of entries into an arc in which an administration's slot can be identified later when they're ready to implement.

Now, this is a map of what we call Region One in ITU parlance, Africa, western Europe, part of the Soviet Union. In our concept of predetermined arc, we associate what we call compatible groups of countries in a given arc segments along the geostationary orbit.

Here, for example, we identified, I think, five countries in this particular group: Ireland, Hungary, Lebanon, Nigeria, and Tanzania.

The idea of the software we are developing to support this planning process is that selected countries can be grouped together and placed in the same arc segment on the orbit in such a way that they would be able to implement their system, at any time they wished in the future, without having to go through the coordination process because, effectively, they will not interfere with each other. They are, in effect precoordinated before they go in there. One of the problems for the developing countries is the whole process of coordination, which is a very technical process. The allotment plan is designed to give them at least one guaranteed orbit position which can be used at any time in the future without the need to go through the coordination process.



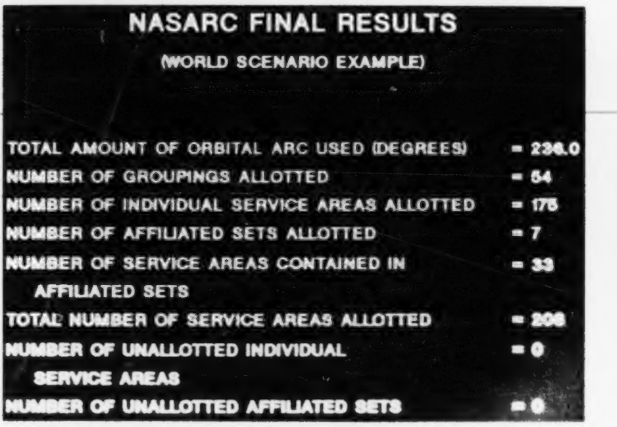
NASARC INPUT PARAMETERS

(WORLD SCENARIO EXAMPLE)

| | | |
|---|---|---|
| SINGLE-ENTRY DOWNLINK C/I (dB) | = | 32.00 |
| DOWNLINK FREQUENCY (GHz) | = | 11.200 |
| GROUPING CRITERION (DEGREES) | = | 0.50 |
| MINIMUM ELLIPSE BEAMWIDTH (DEGREES) | = | 0.80 |
| SATELLITE ANTENNA TYPE | = | RARC-83<br>STANDARD<br>ROLL-OFF |
| SATELLITE ANTENNA EFFICIENCY | = | 0.55 |
| EARTH STATION ANTENNA TYPE | = | 32 - 25 LOG φ |
| EARTH STATION ANTENNA EFFICIENCY | = | 0.65 |
| E/S ANTENNA DIAMETER (METERS) | = | 3.00 |
| RAIN ATTENUATION SELECTION FLAG | = | Y |

This shows some of the technical parameters that go into the specification of each entry in the plan. We say the plan is homogenous in the sense that every entry that goes into it uses the same basic set of characteristics. When the time comes for implementation, if a country decides it wants to put in a system that is different from this basic set of parameters, it may have to coordinate within its arc if the parameters are outside the envelope of the basic set. But this is a fact of life in operating satellite systems. If you go too far off the norm describing your system from what was set up as the plan, coordination will be necessary.

This represents the results of one of our runs. Now, somebody said in the back of the room just a bit ago that the developed countries come to these conferences with their computers and with thousands of computer runs already done. That's true. The United States has too much at risk in this business. We have, I don't know, perhaps 40 satellites in operation in the domestic orbit already, billions of dollars invested in this business, and we cannot go to this conference not knowing what to expect in the way of an outcome. So it's true, we do this. But we intend to explain this process. We intend to take PCs to the conference and set up a demonstration room next to the conference center. We will have people available to demonstrate how this process works to any delegate from any country who wants to see it.



NASARC FINAL RESULTS

(WORLD SCENARIO EXAMPLE)

TOTAL AMOUNT OF ORBITAL ARC USED (DEGREES) = 236.0
NUMBER OF GROUPINGS ALLOTTED = 54
NUMBER OF INDIVIDUAL SERVICE AREAS ALLOTTED = 175
NUMBER OF AFFILIATED SETS ALLOTTED = 7
NUMBER OF SERVICE AREAS CONTAINED IN AFFILIATED SETS = 33
TOTAL NUMBER OF SERVICE AREAS ALLOTTED = 208
NUMBER OF UNALLOTTED INDIVIDUAL SERVICE AREAS = 0
NUMBER OF UNALLOTTED AFFILIATED SETS = 0

Here we show that there were 208 service areas allotted. The service area represents, in most cases, a "footprint" covering a country. In some cases it may take more than one. Canada, for example, requires two, and some of you may not know, but the Soviet Union covers 11 time zones, and so they need to have three service areas.

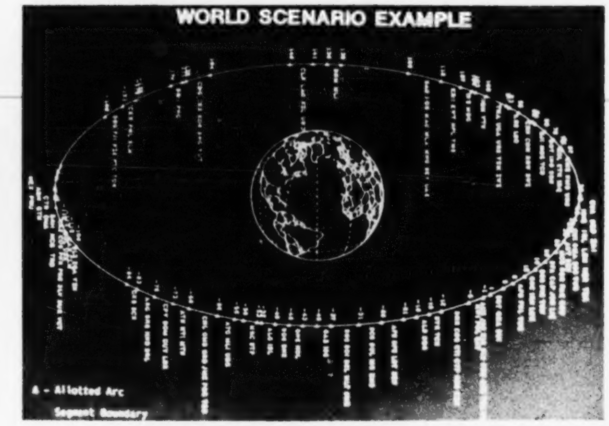
**The United States thinks it is very important that the allotment planning be a success in this first session.**

It takes 208 service areas to accommodate all of the 165 or so members of the ITU along with those special cases like Canada the Soviet Union and even the United States. So we managed to find a place on the orbit for those 208 service areas, and as you see at the top of the chart, we used 236 degrees of the arc. There's 360 degrees in the orbit, so we didn't even use it all.

Here we found a solution for this particular set of conditions, using the techniques that we have begun to develop, that solves the problem of allotment planning and doesn't even use all the resource; in other words, there's still some available for other needs in the future.

The United States thinks it is very important that the allotment planning be a success in this first session. As has been pointed out, the developing countries are concerned about their long-term access to this resource. If we don't find a solution in the expansion bands that were set aside for this, then the conference may start looking at the conventional bands that Skip was talking about or the bands that are used by military systems around the world. This would put a lot more existing systems at risk in the process. So we are very interested in making the allotment plan work.

The last slide shows, one of the example outcomes. Each marked point along the orbit identifies the end of a predetermined arc, and while I know it's unreadable, the strips that hang down from there like Christmas tree decorations are actually the ITU letter symbols of the countries that are placed in each of those predetermined arcs. This is how the particular solution that I was talking about looks in the plan.



If this concept is adopted from the first session, the countries can go away from this conference knowing they have, on a long-term basis, guaranteed access to a good orbit position overhead. That's all I have on the slides and that's all I wanted to say about allotment planning.

**PROFESSOR WIRIN:** First of all, let's see if there are any stones that are coming from the panelists. All right.

**AUDIENCE:** Under the concept of allotting slots, does that country have the right to team, form consortiums? Do they have a right to sell? Do they have a right to lease slots that have been allotted?

**MR. KIMBALL:** Well, I doubt very much whether you could stop them from doing that. However, that's not going to be part of the regulatory provision; that is, to give a country lease rights, sale rights, bartering rights, of one kind of another.

Now, it's very likely, as Skip has pointed out, that many developing countries will satisfy their satellite communication needs by aggregating their requirements into a regional or subregional system. In some cases that's the only sensible economic thing for them to do.

In fact, INTELSAT is very interested in this conference because they see this as an opportunity for a different field of business where they can provide subregional service to several countries that are geographically grouped together. The software that we have developed would permit that; in fact, it's sufficiently flexible, that it doesn't require the subregional groupings be identified at the start of the plan. It permits subregional grouping to be formed afterwards and even allows, we think, the countries in the group to maintain some kind of label on their own position at the same time maybe one of the groups surrendering their position.

**DR. JAKHU**: I just want to add some comments on that. I think once you have an **a priori** allotment plan, it becomes very difficult to barter or sell. I think that's a misconception which has been running around here.

Skip also mentioned about a free lunch. I don't think it's possible in the case of **a priori** planning because technical procedures are already in the plan. Any modification to the plan needs an agreement of the affected countries. They can object to that. So it is a very difficult process. That was the feeling after the '77 plan, also.

But it is possible in the case of the practice of first-come, first-served. We have a practical example nowadays. A U.S. company has already planned to launch a satellite for Papua New Guinea to compete with INTELSAT in the Pacific region. That satellite does not belong to Papua New Guinea but it has been registered in the name of Papua New Guinea because it is going to have a free use of a transponder for its domestic services.

So I conclude that bartering or selling of transponders are possible, and is being done in case of first-come, first-served. In the case of **a priori** plans, it becomes very difficult process.

**AUDIENCE**: The FCC levies dictates of due diligence on could-be commercial satellite owners. Does the ITU have an analogous mechanism on nations, the so-called due diligence? What if, you know, you don't put up a satellite in ten years, do you relinquish that right?

**ITU doesn't have the same kind of regulatory impact and control that the FCC has over domestic licenses, and so the FCC can force things that the ITU can't do.**

**MR. KIMBALL**: Well, there is a provision in the radio regulations that says that after your advance publication, i.e., after your announcement of your intention to put up a satellite, no earlier than five years in advance, if you don't then do it, you are supposed to be removed from the books. To my knowledge, this hasn't really been exercised yet.

It isn't the same kind of due diligence requirement that the FCC has because the ITU doesn't have the same kind of regulatory impact and control that the FCC has over domestic licenses, and so the FCC can force things that the ITU can't do.

If I could, I'd like to come back to this question of "first come, first served" a bit because it's been said here many times this morning. I don't necessarily agree with all that Dr. Jakhu said about first come, first served.

When I have had a chance I have said that really what Article 11 of the radio regulations does is provide that "last come, always served." There has never been a case that I am aware of where a satellite, being put through the coordination hoops of Article 11 has not made it. Sometimes it's been difficult and, in particular, India and Indonesia and France have had some very difficult coordination activities.

Now, it's true that in Article 11 there's some language that says that the newcomer has to get the agreement of those who are already there before he can get on the orbit. There are some provisions in Article 11 that suggest that if those who are there first don't agree to accommodate the newcomer, then, they're not playing the game fair and they ought to try harder.

**Our proposals for the second session of this conference recommend some changes to Article 11 to emphasize the need for those who are there to cooperate with those who are trying to get there and make it a more balanced coordination process.**

Our proposals on multilateral planning have backed away considerably from what we said in the first session. We recognize that the idea of MPM's was originally put forward by the United States. But we don't like the way the first session defined it. We've tried to take a hard look at what is in the interests of countries who are operating satellites, and that includes developed and developing countries, and what is the best way to conduct coordination. Our proposals for the second session of this conference recommend some changes to Article 11 to emphasize the need for those who are there to cooperate with those who are trying to get there and make it a more balanced coordination process.

Article 11, as currently written, doesn't inhibit multilateral discussions on coordination. We believe that if multilateral coordination is forced, that is, it becomes a formal part of the structure of the radio regulations with provisions that say the meetings must be held in Geneva every two years, and all members are allowed to participate even though they may not be affected, because under the rubric of the convention, anybody who is a member can come to a formal ITU meeting and have their say, this puts a tremendous handicap on the real discussions that have to go on between operators of real satellite systems when they're trying to find a way to add a new satellite into an existing complex.

Coordination is a technical problem not a political problem and it isn't feasible to have 40 different countries sitting around a table saying, "Well, we don't agree that you should do it that way."

So we are proposing a much more simplified approach to multilateral coordination than came out of the first session. This proposal plus what I have shown you about the allotment planning approach are the two key aspects of the United States' preparations for this conference.

I will just close by saying that we are trying to present this concept to other countries before we go to the conference. We will be going on the road to talk to many countries in both the developed and developing world.

For example, there's a conference going on in Lone, Togo next week being sponsored by the ITU. We expect 50 or so countries from Africa to attend. We are sending people there to present our ideas and we will be going out both to talk to India and Indonesia and China, as well as some developed countries between now and the end of June.

Thank you.

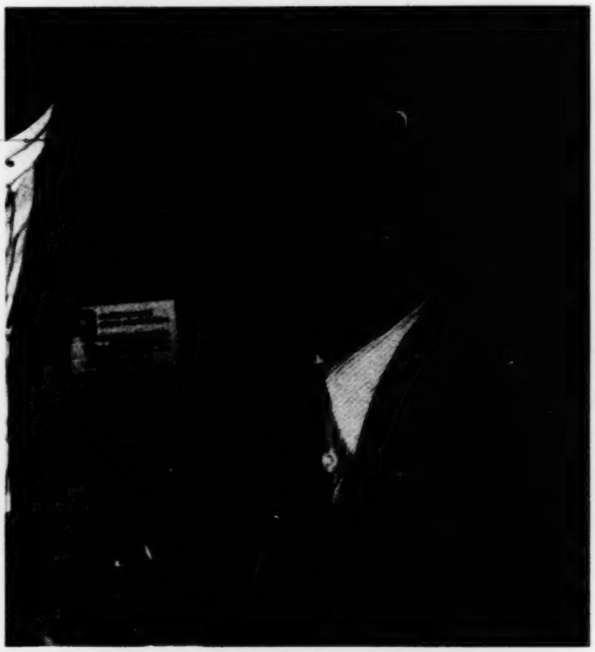
**PROFESSOR WIRIN**: I want to move on to our last panelist, and if you have looked at your program you realize that I am not following that time schedule. I'm aware of that. But what I do want to do now is turn to one of the questions we have not asked and had an answer to: what about the other side, the commercial side, what happens with fiber optics? Where are we going for the commercial guy with regard to this whole telecommunications business?

As I am sure you are aware, there's a newly established Office of Commercial Space Programs within the Department of Commerce, and I am very pleased to have Bruce Kraselsky here who has not only worked with the ITU issues but is now working on the commercial issues and can give us some insight into the Department of Commerce's views and where they think we are going in this area.

**MR. KRASELSKY**: Thank you Bill, for the opportunity to address this distinguished audience. Although I'd like to add to the discussion on the space WARC, I believe the terrain has been well covered by the previous speakers. Perhaps I can broaden the scope of discussion by addressing current and future markets for satellite communications, both domestically and internationally. I would like to do this in three parts. First, I'd like to describe the domestic and international regulatory structure for satellite communications, and the influence it has had on market development. Second, I'd like to make a few points about the increasing competition among satellite systems worldwide. Finally, I'd like to identify some of the directions in which the communications satellite industry is moving in order to survive the competitive threat of alternative communications technologies, such as fiber optic cables.

The international regulatory environment has been shaped principally by the agreements establishing four international organizations: the International Telecommunications Union (ITU), the International Telecommunications Satellite Organization (INTELSAT), the International Maritime Satellite Organization (INMARSAT), and the European Telecommunications Satellite Organization (EUTELSAT).

The ITU, as Major Smith explained in his presentation, establishes regulations and procedures for countries to coordinate their respective use of the radio frequency spectrum, in order to avoid causing each



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**Commercial communications satellite services originated with the establishment of INTELSAT in the early 1960s. INTELSAT's prime objective, as stated in the treaty level agreement establishing it, is to provide the space segment for public international communications services to all areas of the world.**

other harmful interference. It is also responsible for allocating frequencies for the various radio services, including satellite communications. The ITU has treaty status and is comprised of over 160 member nations.

As many of you know, commercial communications satellite services originated with the establishment of INTELSAT in the early 1960s. INTELSAT's prime objective, as stated in the treaty level agreement establishing it, is to provide the space segment for public international communications services to all areas of the world.

Over the years, INTELSAT has grown to become a robust organization, and is an integral part of the global communications network. For years it has carried nearly two thirds of all international telephone traffic and virtually all international video services. Its revenues in 1987 exceeded $500 million. Its current membership consists of 114 nations, including the United States.

INTELSAT's rapid growth can be attributed to a number of factors. First and foremost, it was established at a time in which there was already a well-developed global demand for telecommunications services, but inadequate ground-based facilities to accommodate long-distance communications requirements. The gap was particularly acute for transoceanic traffic. Satellite telecommunications was a natural to fill those gaps. INTELSAT was an immediate success.

Second, the advancements in satellite communications technology over the past twenty-five years have been enormous, and with the result that satellite capabilities have increased dramatically while the costs have plummeted. This was also to INTELSAT's advantage.

Third, the INTELSAT Agreement contains provisions which effectively insulated it from competition for most of its existence. More specifically, Article XIV of the INTELSAT Agreement recognizes the rights of member countries and their citizens to establish or use satellite systems separate from INTELSAT for international services as long as they first consult with INTELSAT. The consultations are intended to ensure that the separate system will not cause technical or economic harm to the INTELSAT organization. The consultations are nonbinding, but they carry substantial political weight. While there have been a growing number of consultations in recent years, most of the separate systems have been severely limited in scope so as not to encroach on INTELSAT's de-facto monopoly. As a result, INTELSAT has been the most important single factor in the development of the international satellite communications marketplace to date.

The INMARSAT and EUTELSAT systems, like every other satellite system established by INTELSAT members to date, went through the INTELSAT consultation process prior to their establishment. The INMARSAT satellite system was established in the late 1970s to provide international maritime services on a global basis. INMARSAT was not viewed as a threat because INTELSAT had no plans to serve the maritime market. INMARSAT's membership currently consists of 54 member nations, including the United States. The INMARSAT Agreement, like INTELSAT's, requires consultations by members prior to their establishment of separate systems serving the international maritime environment, in order to avoid causing INMARSAT technical or economic harm.

EUTELSAT was established in the early 1980s, with the prime objective to provide space segment for international communications within Europe. INTELSAT fought the establishment of this system because of the potential for substantial diversion of international traffic. The consultation resulted in recommendations by INTELSAT that would limit EUTELSAT's lifetime and the service it could provide. It also resulted in extreme bitterness on the part of the European proponents of EUTELSAT. Ironically, the EUTELSAT Agreement was modeled after INTELSAT, and contains consultation requirements to protect it from potential European competitors. EUTELSAT is comprised of 26 European countries.

> **INTELSAT viewed the prospect of privately owned international systems as a threat to its sovereignty...INTELSAT lowered its prices dramatically and created numerous new services in response to the threat of competition from additional service providers. The existing and potential users had already benefited.**

There are two other intergovernmental satellite organizations: INTERSPUTNIK and ARABSAT, but neither have restrictive consultation provisions as part of their charters.

U.S. movement toward permitting the establishment of privately-owned separate international systems originated in 1983, when Orion Satellite Corporation filed a license application with the Federal Communications

Commission. Additional companies filed for licenses shortly thereafter. The separate system proposals ranged from limited competition with INTELSAT to head-to-head competition with no restrictions. The reasons for proposing to enter the international satellite communications market, however, were the same. Specifically, the monopoly environment had succeeded in serving the interests of the satellite organizations rather than the potential users of international communications services. Tremendous opportunities were seen to exist for new entrants willing to provide low cost, innovative services tailored to user requirements.

These applications resulted in major policy debates within the Executive branch, the FCC and Congress. INTELSAT viewed the prospect of privately owned international systems as a threat to its sovereignty, and attempted to use every tool available to it, including the political will of its member nations, to defeat it. In the process of doing battle, INTELSAT proved the applicants correct with respect to market opportunities. INTELSAT lowered its prices dramatically and created numerous new services in response to the threat of competition from additional service providers. The existing and potential users had already benefited.

Despite INTELSAT's efforts, the President announced a policy in 1984 stating that limited competition with INTELSAT was in the national interest. Specifically, the policy prohibits separate systems from interconnecting with the public-switched network, and permits use of the separate systems only by those who purchase or lease capacity on a long term basis. The FCC supported this decision, as did Congress with some additional conditions. Remarkably, one company, PANAMSAT, has been able to overcome these hurdles, as well as much of the international disdain created by INTELSAT, and will be launched this summer.

**In any event, the gates to the international market for satellite communications, closed for so many years, are now being opened. Competition can be expected to increase dramatically, and to have dramatic results.**

Now that the U.S. has thrown its hat into the ring (and taken all of the heat, I might add), a number of other countries seem more willing to participate in the establishment of separate systems. Examples include the Astra system, owned by European interests; the PacStar system, owned by entities from Papua New Guinea and the U.S.; and ASIASAT, owned by entities from the Hong Kong, China and the U.S. These satellite systems will be established during the next two years. Additional systems are in the planning stages. It remains to be seen, however, whether separate systems in which the U.S. is not involved adopt the limitations on competing with INTELSAT. In any event, the gates to the international market for satellite communications, closed for so many years, are now being opened. Competition can be expected to increase dramatically, and to have dramatic results.

The regulatory structure governing U.S. domestic satellite systems is quite different from the international environment. Since INTELSAT's prime objective does not extend beyond the provision of international services, the consultation provisions of the INTELSAT Agreement are not concerned with the economic consequences of separate systems providing domestic services. Therefore, the U.S. established "open skies" policies actually intended to promote competition among U.S. domestic satellite systems, rather that limit it. The result has been the rapid development of a large and extremely competitive domestic communications satellite industry. Ten companies currently operate satellite systems to provide domestic communications services, as well as transborder services to neighboring countries. Collectively, there are more than 30 operational satellites in orbit. Some of these companies have space and ground segments of over $1 billion. The total combined revenues from the operation of these systems in 1987 was approximately $1 billion.

In addition to the U.S. and international markets for satellite communication services, foreign countries have tremendous satellite communications requirements that have only begun to be met. Aside from the U.S., only 12 other countries have their own domestic satellite systems. Five more are planning to establish such systems, and another five are contemplating it. There is a growing market for international systems to sell or lease their transponders to countries within their coverage areas for domestic and regional use. For example, in the last three years, INTELSAT sold more than 35 transponders to countries for their domestic use, and leased transponders to an average of 25 countries per year.

Fiber optics technology is proving to be a fierce challenge to satellite communications, adding to the factors that are currently forcing a shake-out among competing satellite systems. Fiber optic cables can carry a tremendous amount of voice traffic, and the new fiber cables are also capable of carrying video traffic as well. For point-to-point communications, for example, Washington to Los Angeles or New York to London, fiber optic cables are already considered the more desirable communications medium for several reasons. First, the bit-error rate is typically less that in a satellite circuit. Second, there is no echo on fiber communications. Third, there are arguments that fiber is cheaper, but this is still a matter of debate, particularly in cases where distances between points are large. So, it's a very serious challenge.

**Fiber optics technology is proving to be a fierce challenge to satellite communications, adding to the factors that are currently forcing a shake-out among competing satellite systems.**

Communications companies are increasingly opting for fiber optic cables over satellites where there is a choice. In the U.S., there has already been substantial migration of traffic from satellite to fiber, primarily where voice communications are concerned. With the deregulation of the telephone industry, competition is fierce among telephone companies, and customers have made clear their dislike of the echo and delay in voice conversation normally experienced when using satellite links. Internationally, major fiber optic cables are being laid across the ocean basins, connecting major business centers. Adding to the difficulties of the satellite industry in competing with fiber optics is the rising costs of launching communications satellites, and the uncertainty created regarding the availability of launch insurance.

The result is that communications satellite companies are very quickly trying to find niches that cannot be served as efficiently by fiber and other technologies. A number of prospects in this regard have already been identified. Thin route communications, both domestically and internationally, may be more economically delivered by satellite than by fiber. Satellites are also essential as a back-up for large capacity transoceanic fiber networks. Point-to-multi- point services such as video and data distribution, particularly over long distances may be better and more efficiently served by satellite. This niche may be bolstered by the increasing use of very small aperture earth stations, known as VSATs, which allow a business, such a 7-Eleven or WalMart, to connect all of its outlets to a central node for real time data and voice communications at minimal cost. An area in which satellite technology retains an even clearer advantage is in mobile communications services — including voice, data, paging services, radio-location and radio-navigation — on land, sea and air.

In conclusion, the years ahead will be critical for the satellite industry. Competition among satellite systems is increasing in the domestic and international environments. Competition often drives prices closer to cost, stimulates innovation, and causes service providers to devote more attention to the needs of the user community. The effect is both to increase user demand, and to force those less adept at competition from the market. Where alternative technologies are concerned, such as fiber optics, satellites may not be able to compete effectively in all areas, such as the provision of voice services. Rather, satellites will have to aggressively seek market niches in which they have an advantage over alternative technologies. This is already evidenced in their movement toward point-to-multi-point and mobile services.

**An area in which satellite technology retains an even clearer advantage is in mobile communications services — including voice, data, paging services, radio-location and radio-navigation — on land, sea and air.**

**PROFESSOR WIRIN**: Is there a burning question? Let's take a ten-minute break and then come back with the next panel.

**AUDIENCE:** Just one quick question which to me is burning, that is, we heard about the coordination coming up with the Space WARC. What if it doesn't work in the six weeks and there is no agreement, what happens?

**PROFESSOR WIRIN:** There will be a third WARC. That's the way the international bodies solve their problems. If it's not time for resolution, you adjourn, come back two years later and try again.

# REMOTE SENSING IMPLICATIONS FOR INDUSTRY OF THE NEW U.N. PRINCIPLES AND DOMESTIC POLICY

*Moderator:* **Professor William B. Wirin**
Webster Universtiy
*Speakers:*
**N. Jasentuliyana,** Esq.
United Nations Outer Space Division
**Professor Carl Q. Christol**
Professor Emeritus of International Law & Political Science, University of Southern California
**Neil Hosenball,** Esq., Davis, Graham & Stubbs
**Dr. Ray A. Williamson,** U.S. Congress
Office of Technology Assessment

**PROFESSOR WIRIN**: This session we are going to deal with a space issue which will provide, if not the most money, at least a considerable amount of controversy. This is not an area which people should approach with a self-satisfied feeling that you understand it well and that there will certainly be no issues to resolve.

The impetus for this meeting is partially the U.N. principles which came into existence last year. But more than that, we want to explore some of the issues of commercial application, and then late this afternoon, we will take a look at the news media's use of remote sensing information and national security.

We have separated those two panels because the issues are slightly different and we want to narrow the focus as we talk about national security and news gathering this afternoon.

What I intend to do now is to go through the four panelists in much the same manner as we have. If you need explanation as we are going through a panelist's comments, please ask the question. If I feel that there are too many interruptions, I will exercise a moderator's prerogative and tell you to please hold your comment.

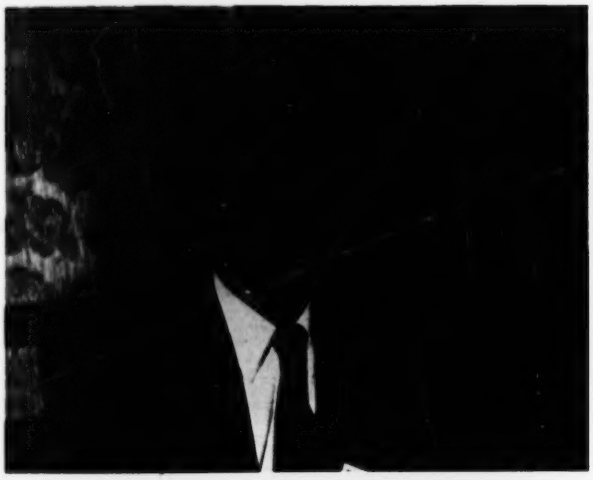
By the way, I should hasten to add that I consider these panels are a success if you came away from them with more questions than you started. I'm really searching here for more questions, because as we go through these land mines, and there are land mines here, we need to be sure that we understand the issues and that we think about them before they are forced down our throats.

So to the extent that we can anticipate what the issues and the problems are going to be, we will have time to reflect on them and to come to some reasonable kind of consensus.

As our opening panelist today, we have someone, really, who stands head and shoulders above his contemporaries.

Mr. Jasentuliyana is a native of Sri Lanka, but he has been with the United Nations now for so long, that in terms of space law, he really is Mr. Space Law for the United Nations. He is a pre-eminent authority. You may have noted in the earlier session that he raised his hand in the back and I have come to learn that when Jasentuliyana wishes to speak, it behooves Wirin to listen.

But I want to pose a challenge to him as he begins his comments and I wish to quote from a short treatise written by a man by the name of Mikhail Gorbachev, who said, "We emphatically stress the need for making the status of important political documents passed at the United Nations by consensus more binding morally and politically." Please answer.



*NANDASIRI JASENTULIYANA was the Executive Secretary of the United Nations Conference on the Peaceful Uses of Outer Space and is currently the Deputy Director of the Outer Space Affairs Division of the United Nations. His publication distinctions include the four-volume* ***Manual of Space Law;*** *and the editor of both International Space Programme and Policies, and Maintaining Outer Space for Peaceful Uses. He is also on the Editorial Advisory Board of the Journal of Space Policy, published in the United Kingdom, and the Journal of Space Law, published in the United States. Mr. Jasentuliyana is the recipient of the 1982 Testimonial Award of the International Astronautical Federation, awarded annually in recognition of important contributions to space law and policy. He holds degrees in Law and International Relations from the Universities of Ceylon, London, and McGill, and is an Attorney-at-Law. He is a national of Sri Lanka.*

**MR. JASENTULIYANA:** Thank you, Mr. Wirin, for your most kind remarks. I'm not sure I deserve them, particularly as I see in the audience the parent of the remote sensing principles Dr. Hosenball here who fathered the principles.

Not only that, I see Mr. Jim Morrison of NASA, who was the other parent from the United States.

So, therefore, any questions Mr. Chairman, including yours, could be directed to these parents of these principles.

Today our panel is supposed to discuss "Implications for Industry of the New United Nations Principles and Domestic Policy." What I would like to concentrate on mainly is the principles and commercial remote sensing.

**The agreement on remote sensing principles constitutes a major achievement for the committee, a result of many years of often frustrating negotiations and profound disagreements over basic issues.**

I see Mr. Hosenball's paper that has already been distributed goes into the negotiating history, so I shall not go into that, and I'm sure he will give you a summary of that part. So let me concentrate on the principles as they are.

The Principles Relating to Remote Sensing of the Earth from Space was negotiated and agreed, by consensus, in a working group of the legal subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, which is called COPUOS. The working group reached agreement in April 1986 and the principles were endorsed by the committee and adopted by the General Assembly in the same year.

The agreement on remote sensing principles constitutes a major achievement for the committee, a result of many years of often frustrating negotiations and profound disagreements over basic issues.

The major obstacles to agreement had been the demand of the developing and socialist countries that the dissemination of data acquired over another country be subject to the approval of the sensed country, and the opposition of the United States and other western countries to any restrictions on data collection and distribution.

The compromise agreement, promoted in particular by French and Austrian initiatives, permits worldwide collection and distribution of data while ensuring that the sensed states have access to data of their territories.

While the adoption of the principles was by consensus, it was not entirely without reservations. The report of the committee notes, "Some delegations expressed the view that, while the agreed principles on remote sensing were an acceptable compromise, they were accepting them on the understanding that the committee would continue to work on that question in order that the concerns of the developing countries would be more adequately met."

While, in fact, there have not been any further discussions of the question, a number of developing countries have subsequently reiterated their continuing concerns.

Because of these concerns, and also reflecting certain reservations on the part of developed countries, the principles were given the status of a General Assembly resolution rather than a more formal "declaration of legal principles" or a legally binding international treaty. There have not been any efforts to upgrade the principles to any stronger status.

**It might be premature to assume that the question of satellite observations of other countries is definitely resolved.**

Of course, the principles as adopted by consensus meets with the requirement that, Mr. Chairman, you quoted, that even though there are moral principles and political principles, that they should be adopted by consensus.

While the controversies over the countries making detailed observations of resources and resource development activities in other countries have largely disappeared since the adoption of the principles, it might be premature to assume that the question of satellite observations of other countries is definitely resolved.

The most dramatic development in satellite remote sensing since the principles were adopted has been the growing interest in and use of high-resolution satellite imagery by news media. We have probably all seen some of the published images of burning nuclear reactors, strategic submarine bases, rocket launching sites, high-power laser facilities, and Middle-Eastern military constructions.

It is not clear whether the remote sensing principles legitimize the acquisition, distribution, and publication of such images.

Principle I defines the term "remote sensing" for the purposes of the agreement as being "for the purpose of improving natural resource management, land use, and the protection of the environment." It is hardly obvious that high-resolution pictures of military facilities fall into any of those categories. It could be argued that LANDSAT and SPOT are remote sensing systems since they were designed primarily for resource applications, but that argument might not be applicable to the proposed Mediasat.

Presumably, part of the purpose of a restrictive definition of remote sensing was to ensure that the principles would not give countries a right of access to data from other countries' surveillance satellites. Since surveillance satellite data has always been very closely held, it has aroused little protest, but if surveillance-type data becomes readily available to anyone who can pay, the situation could change. Indeed, there have been incidents in the past, such as during the Falklands conflict when alleged provision of strategic observations to one side by a supposedly neutral party has provoked complaints.

> **There was no agreed interpretation of what it means to bear international responsibility for remote sensing activities, with developing countries arguing for rather broad responsibility and liability, and western countries arguing for narrow responsibility not going beyond existing international law.**

A further question that could be raised in the future arises from Principle 14,which provides that countries operating remote sensing systems bear international responsibility for their activities irrespective of whether such activities are carried out by government agencies or private companies. There was no agreed interpretation of what it means to bear international responsibility for remote sensing activities, with developing countries arguing for rather broad responsibility and liability, and western countries arguing for narrow responsibility not going beyond existing international law.

Under the principles, freedom is for companies, responsibility is for the states.

> **It was apparent that the earlier fear of aggressive exploitation of Third World resources, based on satellite data, to the detriment of developing countries, were exaggerated.**

The breakthrough in negotiations on the principles in 1985, followed by the adoption of the principles in 1986, after 12 years of negotiations and several years of deadlock positions, reflected changes in both perceptions of the impact of remote sensing and in the general atmosphere of international relations.

After 14 years of LANDSAT operations and continuing questions about the economic viability of satellite remote sensing, it was apparent that the earlier fear of aggressive exploitation of Third World resources, based on satellite data, to the detriment of developing countries, were exaggerated.

In the absence of access to the resources on the ground, the tentative information that could be obtained from the interpretation of satellite data was of little use, and countries still controlled ground access to their resources.

Furthermore, following a period of general North-South confrontation in the 1970s, including a widespread Third World attitude of hostility to multinational companies, there has been a growing recognition in developing countries that economic growth can best be achieved through cooperation with multinational industry. While the identification of exploitable resources in a developing country by a foreign company may raise problems, it is nonetheless generally seen to be in the interest of the country, particularly in the developing countries, to identify and develop those resources.

> **The principles on remote sensing were therefore basically an agreement on economic relations. The use of satellite observations to influence military or political relations, however, could raise new issues**

The last few years have therefore been a period of renewed interest in international economic and political collaboration, and it is in this context that the remote sensing principles were agreed upon by consensus.

The principles on remote sensing were therefore basically an agreement on economic relations. The use of satellite observations to influence military or political relations, however, could raise new issues.

While none of the images of military facilities that have been publicized to date have created any international tensions, if the trend continues, it is perhaps only a matter of time until the government of one country becomes seriously upset by images published by sources in another country and makes a political issue of the incident. The government of the offending country will not be able to plead that it is not responsible for the activities of the private sector since both the principles and the 1967 Outer Space Treaty establish the responsibility of governments for all space activities taking place within their jurisdiction.

Perhaps I should make it clear here that I am not suggesting that either the remote sensing principles or any other international space agreement provide any solid legal basis for any such complaint, nor do I wish to argue that the publication of sensitive political pictures is necessarily bad. Indeed, a strong case can be made for the benefits of broad access to such information and for the view that complaints derive from a desire for secrecy that is not in the best interest. I do not currently see any persuasive arguments for imposing limits on international remote sensing.

My point is that present trends in international remote sensing, in accordance with the principles, could lead to a new source of international tension. While such tension would first and foremost be a concern of governments, it could also affect international business relations. While it appears to be too early to seriously consider any action to deal with such potential tensions, it is not too early for countries involved or prospectively involved in international remote sensing to consider the political implications of such activities and ways of dealing with political tensions that may arise from such activities.

There would, of course, be little action that any developing country could take, either in practice or in law, in opposition to observations of sensitive areas, and it would be easy for the remote sensing agency to simply ignore any complaints. Such a dispute, however, could affect the general relations between the countries concerned and this could have a significant impact on the other activities, particularly when the principles, as you said, were adopted with consensus to give a political and moral basis. This might affect such activities as tourism, expatriates living in the country, and the atmosphere for businessmen with dealings in the country and, indeed, for industry involved in commercial remote sensing activities in the country concerned. If relations between the countries were already awkward, an apparently minor provocation might give rise to a major incident, as last week's rioting in Honduras has indicated. In this sense, if remote sensing did become provocative, it might become an issue that governments would have to deal with in one way or another.

Remote sensing of the earth will never be uncontroversial but there are means to reduce the level of controversy. A recurring theme in the United Nations remote sensing principles, for example, is that of international cooperation, both echoing and extending the principles in the Outer Space Treaty. The principles all speak of international cooperation, the benefits and interest of all countries, and the particular needs of the developing countries.

Principle 13, for example, calls on sensing states to promote international cooperation by making available to other states the opportunity to participate in their programs in order to enhance the mutual benefits to be derived therefrom. States are also encouraged to consider agreements and arrangements for establishment of shared facilities, particularly on a regional basis.

**Remote sensing of the earth will never be uncontroversial but there are means to reduce the level of controversy.**

Principle 8 advocates the United Nations and other agencies to promote international cooperation.

Parenthetically, I might mention that states in favor of freedom of sensing and dissemination of data and information can point to the court of international cooperation in the principles as supporting of their position.

Global and regional solutions to environmental and resource problems can only be achieved in a relatively open regime. Restrictions on sensing and dissemination are not easily reconciled with international cooperation. For there to be cooperation there must be access to information.

It should, however, be stressed here that the emphasis on international cooperation does not preclude remote sensing by private industry, and certainly it must be said that international cooperation is by no means a charitable enterprise but it is driven by self-interest. Why?

International capabilities in remote sensing are expanding rapidly and will continue to do so over the next decade. Although the United States has led the way in remote sensing, more recently the Soviet Union, the Europeans, through the European Space Agency, particularly through SPOT Image, have aggressively marketed remote sensing products from their expanded programs. Japan, China, India, Canada, Brazil, and others are not far behind, and over 100 countries are users of remote sensing imagery. Remote sensing is fast becoming an expanding market in which hundreds of millions of dollars are invested every year. Successful commercial ventures can be built upon this larger market which is inherently international in scope.

I said remote sensing will be controversial and that the United Nations' principles point to international cooperation as one of the means of reducing such controversy.

I also said that emphasis on international cooperation does not preclude remote sensing by private industry. For instance, in the past the telecommunications industry was faced with a similar situation, and the INTELSAT and INMARSAT were created as a means of international cooperation in partnership with private industry. This successful model can be followed in remote sensing where the private sector can play a leading role as in the past; for instance, in the United States, through a consortium, such as a strong EOSAT, just as COMSAT plays a necessary role in telecommunications.

I'm so happy to see that this morning Mr. Hosenball's paper concludes by saying that the time has come now for such an institution.

Let me conclude, then, by saying that the United Nations principles on remote sensing were very much an agreement on economic relations and that leaves the door wide open for commercial remote sensing.

Thank you, Mr. Wirin.

**PROFESSOR WIRIN:** Comments by our panel members? No burning issues? Yes.

**AUDIENCE:** Does the responsibility of the remote sensing satellite owner also tie to proprietary data transfer?

**MR. HOSENBALL:** If you will look at Article 12, which is the dissemination provision, there's one word in there that is key to the proprietary information issue. If you recall the definitions are in Principle I and it talks in terms of analyzed data and what analyzed data is defined as.

If you look at the last sentence of Principle 12, it says that "a sensed state shall also have access to the available analyzed information concerning the territory under its jurisdiction in the possession of any state

**There is nothing in the principles that in any way affects proprietary information. As far as raw data is concerned, that has to be openly disseminated and made available.**

participating in remote sensing activities." Okay, the key word is "available."

Under our system, if it's proprietary, it's not available to the U. S. Government and, therefore, not being available to the state that has jurisdiction over the activity, it is not available to the sensed state unless it's purchased in some way and an agreement is reached. There is nothing in the principles that in any way affects proprietary information.

As far as raw data is concerned, that has to be openly disseminated and made available.

But at the same time, there is other proprietary information that does not need to be made available, such as customer lists, who is asking for particular areas, etc.. That is proprietary under our system.

The work that is done by value-added companies or the companies doing the sensing themselves — EOSAT's doing some value-added work — is not subject to an open dissemination policy under these principles.

**PROFESSOR WIRIN:** Other questions?

Let us proceed, then, to another very heavy hitter. Professor Carl Christol, I am most pleased, joins us today. His work **Modern International Law of Outer Space** is not only the consensus but the unanimously agreed text in the entire area. If you want to get the last word as to what something means, you refer to Professor Christol's text. He has spent some extra pains to take a look at the remote sensing principles, and I would like him to share with you his thoughts and comments and insight into what they are going to mean for all of us.

**DR. CHRISTOL**: Thank you.

The first comment that I shall make is that in 1987 there was a conference of The International Institute of Space Law in Brighton, England. A number of the people there did assess the remote sensing issue; I did. I brought some of my copies of that paper along and they're back there at the back of the room in case any of you would like to have one.

My analysis today is going to look at the historical, the political, and the legal aspects of remote sensing, and I want to focus particularly on the problems that are set forth in Principle 14, which deals with two very interesting ideas, namely, international responsibility and state responsibility, and also on Principle 13 which has to do with the problem of consultation, an issue which was presented to you in a somewhat different context by the first panel this morning.

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On the historical aspect of it, one can certainly conclude that one cannot avoid, in the study of law, in the study of politics, in the study of policy formation, the historical ramifications and background, and this background goes back to the post-Sputnik period and involves the creation at the United Nations of the Committee on the Peaceful Uses of Outer Space which now consists of about 50 countries, of whom about 33 are from the developing world, the balance from the advanced countries.

Also, I have to say in this historical connection that the premise or the principle of consensus is employed in the formation of resolutions and conclusions drawn in the Committee on the Peaceful Uses of Outer Space, COPUOS as it's called.

Now, what do we mean by "consensus"? By that, we mean that there is an inevitable and extended and some would say almost interminable debate as to what the respective principles should be. Ultimately, however, when all of the opposition is beaten down and no vote is taken, the presiding person either in the subcommittee on the law or the subcommittee on science and technology will say, "Oh-ho, we have found that there is a consensus, the gavel is rapped, this is the end of the discussion," and you go on from there.

The important point is that this is then a matter that goes to the United Nations General Assembly, and following the General Assembly's approval of resolutions and recommendations of COPUOS, you go to the treaty level.

The treaty level has been reached in five different areas at the present time. We have not gone to the treaty level, however, with respect to an unsuccessful resolution adopted with respect to television broadcasting, unsuccessful because it was voted down well, it was disapproved by 12 or 13 major countries including the United States and 12 or 13 others abstained. On the other hand, a consensus was achieved with respect to remote sensing principles and the General Assembly gave them unanimous approval without taking a vote in December of 1986. So that's a little bit on the history.

There's also a little bit on the politics, and I suppose that one would have to conclude that politics at the world level is very much like politics at the domestic level. So far as I am concerned, the bottom line who gets what, when, how, where, and under what circumstances and why. These considerations impact on the negotiation procedure that is employed at COPUOS.

Now, on the legal aspect of it, here the lawyers, I think, are to be commended because they are asked to deal with disorderly problems and they do so in an orderly manner. Out of the orderly discussions at COPUOS we have arrived at these five critical treaties that I referred to in passing.

One of those is the 1967 Principles Treaty and it is, as I have said on a number of occasions, the Magna Carta of outer space. To understand it, provisional reference must be made to the historical debates that brought it into being.

With respect to the issue of international responsibility for space activities in general but, obviously, also applicable to remote sensing, we find that back in 1962 and 1963, both the United States and the Soviet Union put in some proposals that had to do with the involvement of countries in space activities.

In a word, the Russians wanted to impose their economic and social preferences upon the rest of the world, saying, in effect, that only nation states could engage in space activities. This was resisted by the United States and the free enterprise countries of the world. Out of this came a compromise allowing the States to engage in international space activities but also nongovernmental entities, namely, private firms and also international and intergovernmental organizations.

**Compromise allowing the States to engage in international space activities but also nongovernmental entities, namely, private firms and also international and intergovernmental organizations.**

The Russians and Americans have been able to compromise or make accommodations, if you like that term better, in many areas with respect to the development of space law. One of the accommodations was that there should be "international responsibility" with respect to space activities. Now, this was kind of a hurricane coming across the political horizon because the term "international responsibility" was not a well-known — in fact, it was an unknown concept with respect to international law. However, the term "state responsibility" was a traditional concept employed in international law. It had to do basically with the protections accorded by one country to the aliens of another country within the host country, a purely hypothetical situation where, for example, an alien would be here in Colorado and a group of ruffians would come along and give him a bad time and the authorities in Colorado were not able to forestall that and maybe the authorities in Colorado were collaborating with the ruffians and didn't take effective measures to try to run them down, bring them before the bar of justice, a lack of so-called due diligence in this area. This is a typical instance where a public entity would fail to conform to the principle of state of responsibility. This is something that you will find as sort of an add-on, a tack-on, in Principle 14.

However, Principle 14 also speaks directly, under the heading of "international responsibility," and it was something that had developed over time in international space law. It had found its way into the sixth article of the 1967 Principles Treaty, and so it has an acceptable tradition within international space law, and not only international space law, but also in those areas where extra-hazardous activities are being carried on.

I would think, for example, that the principle of international responsibility would apply to transborder pollution of the kind produced by the Chernobyl nuclear meltdown which took place in the Soviet Union several years ago. International responsibility is a legal response to the modern scientific developments that are so much a part of the space age.

There has been a contest, as we well know, between the space countries and the non-resource countries, the non-space countries, the advanced versus the less developed, the socialist as opposed to the non-socialist. I would point out to you that the United States and Soviet Union were very much opposed to the claims of the equatorial countries with respect to sovereignty at the 22,300 mile geostationary orbital position. So there are many positions where the Soviet Union and the United States, as space resource countries, look at the prospects for space activity in very much the same way.

**First of all, the trend was toward the utilization of space for scientific and technological purposes just to see how far science and technology would take us.**

Now, space activities, what is the trend in space activities? Well, as time has collapsed, as science and technology have had a more direct impact upon human behavior, as the world becomes smaller, as we become more interdependent, there have been some trends in space activity.

First of all, the trend was toward the utilization of space for scientific and technological purposes just to see how far science and technology would take us.

May I divert from my remarks just for a moment to come back with something which was said I think either explicitly or by implication this morning in the first panel. It seemed to be my impression from what I heard that the orbit/spectrum resource was a "limited resource." Well, that argument seems to be — that proposition seems to be well accepted by many. I reject it, however. I think that it is an unlimited resource and I think it's an unlimited resource by the reason of the fact that science and technology are continually on the move over time to tell us a great deal more about how the orbit/spectrum resource can be explored and exploited and used than we know at the present time.

I would apply that same observation to the second trend in the area of space activity, namely, we are now getting into the commercial field and a part of the commercial field is the remote sensing field, as has already been clearly identified.

I would like, however, for a moment to ask you to consider whether "remote sensing" is the most generic term because I would think that probably the term fact-gathering in outer space should receive the focus of our attention. This would allow us to look at remote sensing, for example, commercial activity, but fact-gathering also in the form of military reconnaissance, and certainly satellites have been used for military reconnaissance in a very, very effective way.

In fact, those of you who have followed the language of the 1972 ABM agreement realize that it contains a provision that technical means of observation, of verification, are lawful. This suggests that these technical viewings are the remote sensing or fact-gathering aspects of outer space activity.

Now, as to the efforts to regulate remote sensing, there have been many efforts going back, I hasten to say, to at least 1970 when the Argentinian representative to COPUOS, ambassador Cocca put a working paper before the legal subcommittee. He proposed that remote sensing was impermissible; it was not to be treated as lawful. It was something that was incorrect, improper, and not to be allowed at all.

However, that notion of the closed skies has given way to the concept of the open skies and now it is abundantly evident to all who take the time to study it that remote sensing as such is a perfectly lawful activity. As a matter of fact, that's what the contest from 1970 down to 1986 was all about, whether or not there should be this area of openness, this area of lawfulness, the legality of remote sensing.

I'd like just to quote a couple of things. As I was preparing my paper, and I have a more technical paper here which I am speaking from, I came across the current Presidential fact sheet dated February 11, 1988, on national space policy. This is what it says.

"The United States rejects any claims to sovereignty by any nation over outer space or celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right of sovereign nations to acquire data from space." In other words, it is lawful to acquire data by way of remote sensing.

**However, that notion of the closed skies has given way to the concept of the open skies and now it is abundantly evident to all who take the time to study it that remote sensing as such is a perfectly lawful activity.**

The interesting thing is that that is word for word the same language which appeared in the 1982 Presidential directive on national space. We have not deviated and, in fact, we have been insisting upon this from 1962 down to the present time.

I have already mentioned the problem of consensus, the difficulty of arriving at consensus, and the paper that I have laid out on the table back there indicates the number of the compromises which were achieved between the developing countries, the socialist countries, and the free enterprise countries from 1970 down to the present time. They were remarkable and it was really a major miracle to my way of thinking, that we could get a consensus in 1986 on these 15 remote sensing principles.

**I want you to realize that had it not been for the acceptance of these principles by the space resource countries, the developing countries would never have agreed to the principles. This was the basic trade-off, namely, responsibility, principles for the acceptance of the other principles.**

Now, let me go on to the two that I wanted to call to your attention rather more specifically. The 14th principle does speak in terms of international responsibility. It also adopts the principle of state responsibility. I want you to realize that had it not been for the acceptance of these principles by the space resource countries, the developing countries would never have agreed to the principles. This was the basic trade-off, namely, responsibility, principles for the acceptance of the other principles.

Now, when you start thinking about responsibility, which is the French word responsibilite, for both responsibility and liability, one must start thinking about reparations at the world level, just as you think about damages at the domestic or municipal level. And so we have, in order to get this thing clearly in perspective, to think about some of the harms or damages which can be possibly proven under the general heading of "responsibility."

The harms come in many hues and colorations, and I'm going to read just a few paragraphs from my prepared paper:

When the United States Senate Committee on Foreign Relations examined the meaning of Article 7 of the Principles Treaty which had to do with liability for damages, the senators asked Ambassador Goldberg what kind of damages fell within the terms of that agreement. He advised the committee that excluded from the coverage of Article 7 were electronic interferences by one country in the radio broadcasts of another state. In accepting this view, the United States took the view that only physical harms fell within the coverage of the treaty.

However, with the entry into the force with the 1972 Liability for Damages Convention, a much wider framework of international tort law was established. During the negotiations, a consolidated list of national proposals consisting of 22 single-spaced, typewritten pages was prepared for COPUOS. From this came the general rule for space damages contained in Article 12 of the Liability for Damages Convention.

By the way, both the Magna Carta and the Liability for Damages Convention have been ratified by 80 or 90 countries including the United States, the Soviet Union, the Peoples Republic of China and, in fact, all of the major space resources in the country.

**There is much support for the view that international law accepts the existence of direct, indirect, and moral damages, with indirect being a subset of moral damages. The latter had been identified as including pain and suffering, humiliation, and the loss of capacity to enjoy life.**

Now, Article 12, which established the norm for recovery of damages in space activities, provided for the application of "international law and principles of justice and equity, in order to provide such reparation with respect to the damage as will restore the person, natural or juridical, state or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred."

So that's a fairly broad and a fairly, I think, acceptable proposition. We could try to make the person whole, as American lawyers say.

Nonetheless, much attention has been given to ascertain what kinds of damages might be claimed under international law as well as, and in addition to, the separate principles of justice and equity.

There is much support for the view that international law accepts the existence of direct, indirect, and moral damages, with indirect being a subset of moral damages. The latter had been identified as including pain and suffering, humiliation, and the loss of capacity to enjoy life. The United States has been supportive of these bases for asserting claims for space-produced harms.

There is also support for the view that actual, compensatory, and foreseeable damages resulting from space events, namely, remote sensing, are covered by international law.

The remote sensing activities might, in some situations, result in loss of profits, personal injuries, loss of earnings, medical expenses, pain, suffering, and mental anguish. Excluded from this litany are the so-called nominal or punitive damages.

Now, probably the strongest case against a sensing state would be for its providing of data or information, in the language of the principles, either knowingly or negligently of false, misleading, or inaccurate data or information to a sensed country whereby the latter, including its residents, experience some kind of harms identified above.

In light of the historical antecedents of the doctrine of international responsibility, claims presumably would be based on this proposition. If such facts were to exist within a municipal law situation, then the doctrine of state responsibility, including its reference to imputability respecting the rights of individuals, would be properly invoked.

This may be confusing to you who are not lawyers. The notion of imputability simply is that if a private person is harmed by a remote sensing activity, then that private person takes that problem to his country, the United States Department of State, for example, which would then pick up that claim and say, "This is now the U.S. claim and we are going to present this claim against that country which disclosed this false or fraudulent or negligently included material."

**If you can have consultations between the resource countries which engage in remote sensing and those countries which possess the data or information, this may reduce the possibility of harms.**

Although commentators have frequently drawn no sharp lines between international and state responsibility, one way to do so in the area of international remote sensing is to apply the state responsibility doctrine to the conduct of nongovernmental entities allowed by a state to engage in international remote sensing activities.

Quickly, I want to call your attention now to the 13th principle. The 13th principle calls for consultation, and I think this is a therapeutic provision; namely, if you can have consultations between the resource countries which engage in remote sensing and those countries which possess the data or information, this may reduce the possibility of harms. It would be in keeping with the general thesis that damages should be prevented as well as minimized and reduced over time.

Well, here you have these principles. Now, what is their legal significance? They're not a treaty. There have been some voices raised at the United Nations saying that they should not be put into treaty form. What does that mean? Does that mean that they're not significant, that they're not prescriptive?

The answer, in simple words, is that they have enormous legal consequences. And why? Because international law relies both upon treaties and upon state practice to determine what states and private firms can do.

As to the subject of private practice or practice for many long years now, the United States and other space resource countries have been engaging in remote sensing, private firms have been engaging in remote sensing, international legal institutions, such as the United Nations and the specialized agencies and others have been engaging in remote sensing. It seems to me that the events have gone on so far and so long that remote sensing is seen as a right under customary international law. When you add to that the adoption of the General Assembly resolution in 1986, put those two together, and you have a case that is as strong as a treaty case to say that there are rights, there are limitations on these rights, and that it's going to go forward in that fashion.

**I don't see that the treaty route would add anything to the assurances or the guarantees that exist at the present time.**

It may be that at some future day there will be an interest in going the treaty route. I personally would not be opposed to that, but I don't see that the treaty route would add anything to the assurances or the guarantees that exist at the present time.

In short, this has been a great victory for those who believe in an open society. This has been a great victory for those who believe in open skies. This has been a great victory for those who believe that science and technology should not be thwarted by legal regulations which would limit or try to prescribe limitations upon their use, and so on.

So, to me, this has been a marvelous achievement and I hope it will be seen by you just as that, and I thank you very much.

**PROFESSOR WIRIN**: Comments, please.

**MR. JASENTULIYANA**: Just a very brief comment. I think it was Dr. Christol, in his opening statement who quite inadvertently mentioned that the United Nations committee was made up of 40 countries.

**DR. CHRISTOL**: No, I did not say 40, I said about 50.

**MR. JASENTULIYANA**: And I think he mentioned 33 developing countries.

**DR. CHRISTOL:** That is correct.

**MR. JASENTULIYANA**: Yes. I'm sure he intended to say 53, in any event.

I want to mention here that, in fact, all of the United States, Canada, and all of the western European countries are members of the committee and all of the eastern European countries are members of the committee. So it's quite a well-balanced committee. If you look at the active participation, no more than three or four countries from Africa and three or four countries from Asia are really active in the company because, again, going back to what I said in the earlier panel, of lack of expertise in many cases. Of course, even when they have people, they cannot cover several meetings at the same time, because of the lack of qualified numbers of people. And the rest actually come from Latin American countries, which are not necessarily unfriendly towards the western countries; all of Argentina, Brazil, Uruguay, Mexico, all of the big Latin American countries are members of the committee.

Now, I must mention here something that happened in the committee, and this is true of ITU also: some of the Third World countries now can no longer be lumped together, as they were in the '60s and perhaps in the '70s. You have, among the three or four African-Asian countries that are active in the committee (like India, Pakistan, Indonesia), countries which are now very much space-fairing countries. Their interest, most of the time now goes along with the United States and the Soviet Union, as major space powers. In fact, India was the leader of the developing countries in the '60s and '70s, and right now India is almost at odds and almost frustrating the expectations of the developing countries in the committee. I think more and more Latin American countries like Brazil, which used to be, again, the leaders in the Third World countries and the committee, now have their own interests. So I think, as the gentleman from the other panel said, now, countries, when they come to this, you cannot give them block views; they look after their self-interest and these change from time to time.

**India was the leader of the developing countries in the '60s and '70s, and right now India is almost at odds and almost frustrating the expectations of the developing countries in the committee.**

**DR. CHRISTOL**: Well, could I just respond by saying I think that you are helping to prove my point, which is simply that there has been a collapse of time, there has been a Joining together in terms of interrelationships, and that these interrelationships are based more upon science and technology than they have been in the past upon the so-called sovereign prerogative.

On the other hand, one has to watch this because the notion of sovereign equality is something that these developing countries carry very much in the form of a placard above their heads whenever they go to international conferences. And so sovereign equality is something that you cannot put off to one side. It was for that reason that I said that I thought this was a marvelous and almost unrivaled achievement, to have these developing countries sort of thrust that placard of ultimate national sovereignty to one side and to try to live in a world of communications rather than a cocoon of obscurity, if I could use that expression. There are many of the developing countries that are very keenly offended over the fact that the satellite process can be an attack upon their fragile cultures. Therefore, they do not really want to have the full communications concept as we in our own democratic system think so important. They do not wish to have that implemented to the same extent that the advanced countries do.

**Sovereign equality is something that these developing countries carry very much in the form of a placard above their heads whenever they go to international conferences**

**MR. JASENTULIYANA**: I didn't mean to take issue with you, I just meant to clarify something.

**MR. HOSENBALL**: I think one of the reasons why the consensus of the principles was reached was basically because of something that did happen in the ITU.

As was mentioned this morning, the ITU covers the entire electromagnetic spectrum, from visible to invisible, radio astronomy, everything; and there was a portion of the spectrum reserved for passive sensors, that is, to sense physical objects on earth that were reflected from the ground up to the satellite.

**We overruled the FCC, through the support of state, and the instructions to the delegation were to preserve the remote sensing spectrum.**

I forget when it was — if Hal is here he can probably recall — but at one of the major ITU conferences, the question was raised by the FCC, actually, our own FCC, about taking part of that spectrum for other uses much to NASA's opposition.

At that time I was in NASA and Hal Kimball had joined NASA and we were concerned that the use of this portion of the spectrum would be impacted because the ITU is so communications oriented.

To avoid that happening, we overruled the FCC, through the support of state, and the instructions to the delegation were to preserve the remote sensing spectrum.

Hal Kimball mounted a major road show to take around to various countries to point out the importance of these frequencies to remote sensing and the importance of remote sensing to the developing countries.

Our major support at that ITU conference in preserving these frequencies, since if the United States had asked to preserve them it may have been looked on a little bit differently, we solicited the support of the developing countries. They supported the position and, in fact, those frequencies were preserved.

So things do change. You now have developing countries that are now seeing the benefits of the use of remote sensing data, particularly for agriculture, for planning, etc., and the developing countries recognize remote sensing as a useful tool. Positions of other countries has evolved from a very hard-line position in the early days of the U.N., no right to sense, even some talk about no right to overfly. The widespread use and a demonstration of its benefits over the last 11 years allowed COPUOS to reach a consensus in 1986. I think this was a major achievement.

**PROFESSOR WIRIN**: Questions from the audience?

Well, let me formally, then, introduce Neil Hosenball. He now is a practicing attorney. Probably his major claim to fame is as general counsel for NASA, and in that capacity, he was called upon by the various administrations over the years to be a principal negotiator for the United States in COPUOS, to hammer out the treaties which we now have that govern outer space, and to say that he probably is a man that needs no introduction. I would only add to things. When I tell somebody that I'm involved in space law, they say, "Oh, then you must know Neil Hosenball." The conversation goes downhill from there.

But if you want to know where the bodies are buried, Neil is certainly the one that can give you a clue as to where the headstones are, and I suppose somewhat facetiously, I might observe that for many years COPUOS was very productive and then they went into a very slow period, and that slow period happened to coincide with Neil's leaving his responsibilities as principal negotiator and it has only been in the last couple years that they have recuperated from his absence.

So, Neil.

**MR. HOSENBALL**: What I would like to do is direct my comments on the effect of the principles on domestic policy as well as on this newly developing remote sensing industry. I do think it is important that you do study the principles. I'm not going to go through all of them. Several of them impact the commercialization of remote sensing, but there were two others, three others, that I'd really like to talk about.

First, I think that the definition is very important, and particularly, as I mentioned earlier, the differentiation of the various kinds of data that do result from remote sensing activities.

The definitions that are used domestically, don't necessarily comport totally with the definitions in the principles, but I don't think that makes that much difference.

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Principle I talks in terms of primary data and others call it raw data. That's data that's dumped from a satellite to a ground station.

The term "processed data" generally would mean some work done either through rectification, which is a process of locating where that data came from or calibrating the sensors themselves.

In talking to Ray, I didn't ask the question that Major Smith asked, "How many people know anything about remote sensing?"

I have asked Ray to at least give us a short tutorial on what remote sensing is and what it does.

The key word is "analyzed" information, and there we get into the questions that I mentioned earlier of somebody taking the data, even if processed, and using the data from other sources, such as ground truth. Ground truth means that someone makes a visit to the particular location that has been remotely sensed, brings additional information back about the location, compares it, analyzes it, and then from that flows useful information. That's what we're really talking about when we say "analyzed data." It is the information that flows from the totality of the information one receives related to the particular purpose for obtaining the data. A piece of that information being remote sensing data.

**The U.S. took the position from the very beginning that we're a nation that believes in the free flow of information across national borders and having taken that position, we asserted the right to sense and the right to distribute the data on an open, nondiscriminatory basis.**

In Principle 12, the word "analyzed information" is used. The biggest problem in — trying to reach a consensus was the issue of how and in what way would this analyzed information be disseminated by the operators of remote sensing systems.

As was indicated, the U.S. took the position from the very beginning that we're a nation that believes in the free flow of information across national borders and having taken that position, we asserted the right to sense and the right to distribute the data on an open, nondiscriminatory basis. That was, of course, for civilian remote sensing systems; basically, the LANDSAT system, which at that time was the only civil remote sensing system in existence.

On the other hand, as pointed out, there was a strong sense of what is called sovereignty which Professor Christol previously discussed. To the point where some countries, particularly the socialist countries and some of the Third World countries, took the position that they had sovereignty over any and all information about their country, no matter how it was gathered. They even argued at one point that they could stop you from taking maps, railroad maps, or railroad timetables out of the country if they so desired. Now, that's easy to do. You stop them at the border and you take the stuff away. But what do you do with remote sensing data? It never gets to your country. It is in the possession of whoever has a satellite. But that's the kind of strong feeling that did exist in the early days.

The question of the right to sense disappeared fairly quickly, primarily because of meteorology. We had weather satellites operating over a long period of time. That information was being made available worldwide through the use of rather inexpensive systems on the ground, and so the right to sense disappeared as an objection.

**The Third World countries, took the position that they had sovereignty our any and all information about their country, no matter how it was gathered. They even argued at one point that they could stop you from taking maps, railroad maps, or railroad timetables out of the country if they so desired.**

But it took a long time to reach agreement and to come up with words, which are basically compromise words, and which I assume that when a dispute arises will be viewed differently by countries depending on the advocates of one interpretation or another. But it's quite clear that the U.S. view was that the U.S. does not have to make available "analyzed information" that is not in the possession of the United States Government.

Now, generally, unless there are changes to the Freedom of Information Act, there is very little proprietary data in the government's possession. I think this was a key element and I don't think a consensus could have been reached without such an interpretation. There was no way that the U.S. was going to make available to anyone data that has been analyzed by private concerns in this country.

A corollary principle that concerned particularly the developing countries, is found in Principle 4, and Carl Christol addressed that — in one way. I would like to approach it from a different position.

**It's quite clear that the U.S. view was the U.S. does not have to make available "analyzed information" that is not in the possession of the United States Government.**

If you look at the Principle 4, you see in the last two sentences that remote sensing activities shall be conducted on the basis of respect for the principle of full and permanent sovereignty of all states and peoples over their own wealth and natural resources, with due regard to the rights and interests of other states. This was the compromise reached at the COPUOS.

The U.S. representatives argued many, many times, and time and time again, that remote sensing doesn't take your natural resources away- you still have national borders. If somebody comes in and wants to take out your natural resources, you have many, many ways to take care of that; you just don't let the resources out of the country.

The argument, on the other hand, was made, "Well, you know, the industrial countries will have all this information and they can take advantage of us in concession agreements and in negotiations." And the counter-argument was, "Well, if it's that bad and it's happened before, you can expropriate the concessions. You may get into diplomatic trouble but you can still protect your own self-interest."

Notwithstanding, there was the concern, and if you will look at the last sentence, "Such activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed state."

**I don't agree that the Liability Convention covers to the kind of damages that might result from a misapplication or misinterpretation of remote sensing data.**

Does that translate into damages if something does happen that may be detrimental?

I don't agree that the Liability Convention covers to the kind of damages that might result from a misapplication or misinterpretation of remote sensing data. I think the U.S. position is quite clear that the Liability Convention was intended to cover physical injury to person and property, not this kind of intangible damage that might result. That is not to say that Professor Christol may not be right when it comes to general international law because there is a concept of state responsibility that might be applicable. But I don't think the Liability Convention would apply.

Again, it ought to be remembered that these are government-to-government agreements whether principles or treaties. They may apply to commercial activities, there is a whole line of supreme court cases which say when a treaty is self-executing it affects individuals or companies within the United States.

However, as to remote sensing, the U.S. did not wait to see whether the Outer Space Treaty would apply to remote sensing. We did, under the Outer Space Treaty, enact domestic legislation to assert the jurisdiction and control and state responsibility is required by the '67 treaty. That legislation is the Land Remote Sensing Commercialization Act of 1984. It consists of 17 pages of small type, and it can be found at 15 USC 4201, and on and on and on.

**I...don't find anything in the statute or the regulations which create a serious burden to commercial operations. It is largely a licensing provision.**

Again, looking at it, in addition to the statute, there was a requirement for the issuance of regulations and now, I believe, NOAA has issued final regulations.

**AUDIENCE:** Yes.

**MR. HOSENBALL:** It took a long, long time to get them final, but they are now in the CFR.

I, again, without going into detail, don't find anything in the statute or the regulations which create a serious burden to commercial operations. It is largely a licensing provision.

I think in some areas, particularly in the protection of data, the data itself and the right to reproduce it, could have been stronger. I think it could have been stronger in the area of proprietary rights, but on the whole, I find nothing in the act or the principles or in the regulations that creates a major burden other than the burden of having to go in and complying with the regulations and doing all the things necessary to get started in order to get a license.

Let me at this point end, as time is passing, and I'll turn it back to Bill.

**PROFESSOR WIRIN:** Comment?

**MR. JASENTULIYANA:** On this last matter you raised, I think I am inclined to agree with you and, of course, Professor Christol. But if you look at the liability agreement, while it says that the term "damage" covers the loss or damage to property of states, it also says in Article 2 that a launching state shall be liable to pay compensation for damage caused by its space object.

Now, a company interpreting, and then misinterpretation, I do not believe that this could be argued to come in under Article 2 which says the damage must be caused by the space object. So I'd like to say that I am inclined to agree with you there.

**DR. CHRISTOL:** Well, may I just say that I think that the point is well taken. My purpose in looking at the Liability for Damages Convention, which does deal with collisions, obviously, is simply to point out that there is an extra hazardous involvement on the part of space objects, and in the process of such hazardous activity, there's a cautionary need to be sure that your behavior is such that you do not impose harms or damages. This harm or damage could result from selling the analyzed information which is wholly incorrect, and as a result of that someone suffers some kind of detriment.

**PROFESSOR WIRIN:** Questions from any of the audience?

If not, let us go forward. Those of you that know Art Dula may well appreciate that he is not sitting to my far left. But I am pleased to announce that Austin Dula was born yesterday. Mother and child, and I believe the father, are all doing well. Austin, at his initial entrance on our planet, weighed something in the neighborhood of 8 pounds 10 ounces, so I guess his time had come.

But I have asked Dr. Ray Williamson to join us on this panel; frankly, not as an afterthought but as a real contribution. You will notice that he is a panelist listed for this afternoon, and I can assure you that you will not miss the opportunity to hear his thoughts, specifically in the Mediasat area. But he has been working remote sensing in the Office of Technology Assessment, and I'd like to ask Ray to give us some feel for the applications to the United States and the commercial activity which may well result from these principles and from the legislation as it exists.

**DR. WILLIAMSON:** Thank you, Bill.

Neil Hosenball suggested that I might spend a couple of minutes looking at some of the technical aspects of remote sensing, to give people the sense of what remote sensing is all about.

Let me just say that, very simply put, remote sensing from space from a technical standpoint involves a telescope at the focal plane of which is some sort of sensing medium, whether it's a photographic film, as in many of the early attempts at remote sensing from space, or an electromechanical or electroptical sensor, such as we now use today in the civilian systems; and that electroptical sensor allows transmission from space electronically to earth in a manner very much like communication satellites. The major difference is that the remote sensing satellite, instead of sitting at a geostationary orbit over the equator, follows a path that goes nearly over the poles, and basically passes over the entire earth. After so many days any given polar-orbiting satellite will pass over every part of the earth.

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The sensors can detect light in either black and white (panchromatic) or in color. The reason for sensing in color in general is not to produce wonderful technicolor images of the earth's surface but in fact to allow discrimination from objects on the earth's surface.

To give you one simple example, corn looks slightly different in color from space than soybeans, so you can actually discriminate whether fields are growing corn or growing soybeans. You can also do all kinds of other wonderful things using infrared and radar images.

**Corn looks slightly different in color from space than soybeans, so you can actually discriminate whether fields are growing corn or growing soybeans.**

Just to give you an idea of the kinds of systems that are up now, we have the U.S. LANDSAT system, the French SPOT system, and a variety of Soviet systems, including photographic systems on the MIR space station. There's also a Japanese ocean remote sensing system flying. They operate at various resolutions, and the resolution that you hear talked about, seen, and it becomes so important in discussions of all kinds of economic or political issues, has to do with the ability to discriminate between objects on the ground. That's what we mean when we talk about resolution; it generally is stated in terms of meters or feet.

The first LANDSAT system that the U.S. flew enabled you to discriminate objects that were 80 meters across, which is about 250 feet or so. So it wasn't very discriminating.

We now have you flying the SPOT system which allows for 10-meter resolution, and if you work the data a bit in computers on the ground you can improve its resolution to about 5 meters. So it allows you to discriminate between objects sitting side-by-side that are roughly either 10 meters, or 5 meters in size. Obviously this is the realm of being able to see bridges easily, or even trucks on bridges. But you couldn't generally discriminate between, say, one kind of fighter aircraft and another at those levels.

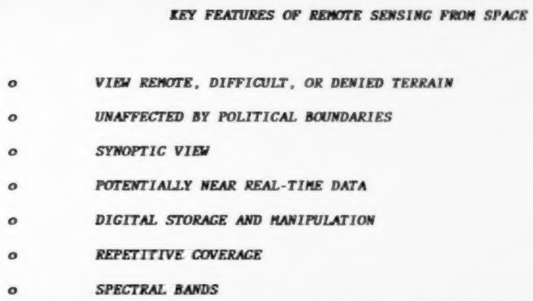
This afternoon we will obviously get into questions having to do with the resolution when we talk about the Mediasat because there the issue is much higher resolution in order to use those data for the news media's purposes.

**One of the special things that's happened very recently is the availability of these data for use in an ordinary personal computer**

Well, obviously I have been talking about the civilian systems. What military systems are up is highly classified and the resolutions involved are also highly classified.

The first chart presents some of the key features of remote sensing from space.

The satellite is unaffected by any political boundaries it passes over. It also gives us synoptic view, in other words, it can look at a large area at once. It can image

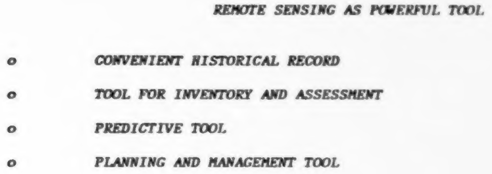

KEY FEATURES OF REMOTE SENSING FROM SPACE

- VIEW REMOTE, DIFFICULT, OR DENIED TERRAIN
- UNAFFECTED BY POLITICAL BOUNDARIES
- SYNOPTIC VIEW
- POTENTIALLY NEAR REAL-TIME DATA
- DIGITAL STORAGE AND MANIPULATION
- REPETITIVE COVERAGE
- SPECTRAL BANDS

the same area again so many days later, or if you've got enough satellites up, the next day.

The other really important point from the standpoint of making use of these data is digital storage and manipulation. Once those data are on the ground, they are available for computer manipulation.

One of the special things that's happened very recently is the availability of these data for use in an ordinary personal computer, and I suspect EOSAT may have something to say about that later on. It allows for use by end users that are much further down the line in terms of their understanding and capability with respect to remote sensing systems than ever before because you don't need to have a large main frame computer anymore to make use of these data.


REMOTE SENSING AS POWERFUL TOOL

- CONVENIENT HISTORICAL RECORD
- TOOL FOR INVENTORY AND ASSESSMENT
- PREDICTIVE TOOL
- PLANNING AND MANAGEMENT TOOL

The second chart lists some of the aspects of remote sensing; obviously, it's a very convenient historical record. It's also a general tool for assessment and inventory. For example, it's used for determining archaeological resources. Now, that's not a very big market, but it is an interesting one that you can actually detect from space if your resolution is high enough. Remote sensing from space can also be used to detect geological resources such as oil, gas, and minerals. It can also be used for disaster monitoring and as a predictive tool. In addition it's useful for detecting crop condition. You can detect things from space in a field, of say, corn or soybeans long before you can detect it on the ground visually. Remote sensing is obviously a very useful tool for managing forests and for developing a sense of the onset of natural or technological disasters. It's quite useful as a tool for land management, rangeland development, planning, mapping, and for geographic information systems. And, finally, there's been lots of talk, which I will explore further this afternoon, about using remote sensing for the media.

**The U.N. principles give much greater certainty to the market than they ever did before.**

Now, I want to mention a couple of things that occurred to me as I listened to the conversation here. I'm not a lawyer, so I can't get into the legal details that were mentioned before. However, one of the things that comes through loud and clear to me is that the U.N. principles give much greater certainty to the market than they ever did before.

Ten years ago when I first began looking at this business, there was a lot of concern over financial and legal uncertainties. Could you get financing for systems? Were data formats going to stay the same? We have solved these and other economic and technical problems The U.N. principles go a long way toward resolving whatever political uncertainties we might have.

That doesn't mean there won't be controversies, as has been mentioned, but from the standpoint of developing the market for remote sensing, this is very important, I believe.

Now, there's still great concern among the developing countries that we have talked to. They wish for broad access to the data. They want to use the data for economic development, and that relates to not only access to the data themselves but also training in how to use the data.

One of the concerns that I have had as I looked at this is making training available to developing countries who may want to use these data. At one point the U.S. was in the forefront of that, but lately the U.S. has not been spending the kind of money to make that possible and so it's been turned over, if you will, to the other remote sensing entities of the world and also the private companies. Clearly from the companies' standpoint, it's good business to provide as much training as they can afford to provide, but I would hope the government might look at the possibility of providing more training.

**The problem I see at this point in establishing some sort of international remote sensing organization is that we now have a number of private concerns**

As I mentioned, we have a very fine NASA program and it's my belief that the NASA program which USAID and NOAA also contributed to and, of making those data available to other countries in the world, helped to establish a market and also helped with the establishment of U.N. principles that we discussed earlier today.

Now, Neil Hosenball mentioned briefly the possibility of an international organization. That is a notion that John McLucas and others have put forward. The problem I see at this point in establishing some sort of international remote sensing organization is that we now have a number of private concerns — several private concerns and other countries in the business today. They have not yet, to my knowledge, seen it in their best interest to establish an international organization beyond the coordinating mechanisms that are necessary for standardizing data. However, that's a very important function that might eventually work itself into an international organization.

One of the reasons for looking toward an international organization is the cost of the systems and the cost worldwide in the proliferation of these systems.

**I personally believe the real market is going to be in the value-added services.**

Some mention has been made of other countries, but, in fact, by my count there are about ten different systems which will be available with different spectrum bands and different capabilities in the early '90s. So you've got such a wide proliferation of systems that the question becomes, how can we make those data most available to all countries of the world and establish a market for the data. I personally believe the real market is going to be in the value-added services. I suspect we will hear more about that this afternoon. It's not the initial data, that will generate the greatest income, but the whole value-added industry, including computers and inexpensive data products for end users.

**PROFESSOR WIRIN**: Thank you very much, Ray. Time, maybe, for a comment by a panelist.

**DR. CHRISTOL**: I wonder if I could ask the last two panelists about their views on organization. I suppose this would be an operational organization, but I'm wondering in terms of organizations of the world at large whether or not there is room for a specialized remote sensing organization for space or whether there ought to be a combination or variety of functions put under the heading of an operational space organization.

**MR. HOSENBALL**: Well, we have specialized groups now. We have the INMARSAT, which is maritime; we have INTELSAT, which is communications. I think there is some utility in an international remote sensing operational organization.

It is costly for each country to operate a remote sensing system. I don't see any reason why there can't be a chosen entity in each of the countries, whether it be SPOT for Europe or EOSAT in this country, and going around the world. As you know, you had PTTs in existence to join INTELSAT. I don't see why it can't work. I think you have to look at the economics. Does it pay to have an international organization? How will you get the investment? How will you share all the things that INTELSAT and INMARSAT have gone through? But I think it could be a very, very useful project and I'm glad to see that John McLucas is speaking very strongly in favor of it and is trying to move it forward in some way.

**DR. WILLIAMSON**: Well, let me just comment that there are — as I have seen this idea put forth in a number of different forms, that there are both interest and considerable resistance to it. One of the places of resistance is in the question of whether this remote sensing organization would also distribute the METSAT data. We haven't talked about the meteorological satellite data at all but there are already in existence a number of organizations that try to coordinate the collection and distribution of meteorological satellite data. So in putting an organization together, one has to think about those organizations and how they would fit into a remote sensing organization that was directed more toward the kind of remote sensing data that we have been talking about, namely, the earth's surface and the oceans.

**PROFESSOR WIRIN**: Comment?

**AUDIENCE**: Yes, I would just like to make a point and see what kind of response you get.

What I hear you suggesting is another organization that would seemingly take on the same kind of characteristic that INTELSAT and INMARSAT have in the past, and that while initially the United States heartily endorsed that kind of structure, because of the costs and benefits down the line ten or fifteen years, there is growing regret that now we are locked into something we can't necessarily get out of and has a significant effect. Do you think maybe the same kind of considerations do apply here?

**DR. WILLIAMSON**: It seems to me that one of the concerns we face, which Bruce has correctly pointed out, is the change of an organization over time. We certainly have seen challenges to the structure of INTELSAT and I think we are beginning to see it also in the case of INMARSAT. In the future perhaps we could take such changes into account from the beginning. I think we can learn from the lessons of INTELSAT and INMARSAT to structure an organization that has built within it opportunity for change as you go along. I don't know how to do this yet. I haven't looked at it in enough detail, but it seems to me that you could allow for it ahead of time.

**MR. HOSENBALL**: It has to be a treaty organization or, it's not going to work because you do have national security considerations involved, and so you may have to do something about resolution and all sorts of different kinds of problems that you may not have with INTELSAT and INMARSAT. The media question is another one, so you have to really look at it. But I think it would have to be a treaty organization that would have to evolve as Intelsat has evolved, as Inmarsat has evolved. They're moving out of what they consider their specialty niche into other areas. I think it can be done but it's going to take some careful consideration and certainly probably an overriding national security consideration. I think it's going to have to be looked at very, very closely.

**MR. JASENTULIYANA:** Yes, I just wanted to say that I think, as Mr. Williamson pointed out in his discussion, you have all these different systems with different parameters and these countries are supposed to keep up with this. You have the LANDSAT ground stations and then you are told to change them into an acceptable support system, and this costs millions and millions of dollars. For Third World countries, which is a big market in remote sensing, it is going to be very costly, and this means, I think, this will restrict the size of the potential market eventually if you put this kind of overhead costs on the countries. Then you have all these things like INTELSAT and various parameters at the same level, the cost is much higher, very much higher. And I think even Mediasat might be looked at to be combined.

I think one of the things that will benefit by this are in fact the problems that are being risked in connection with the Mediasat because you will have in such an organization (if it is a treaty organization), the governments involved, which will have various resolution factors, whether it's 5 meters or ten meters or whatever. So the political aspects of that could be taken care of by the governments within the organization so that the users of the proposed Mediasat will not have to get into those problems.

So I think there's a lot to be said when you look at it, and as Mr. Williamson said, this organization can always be structured in such a way there's flexibility, evolving flexibility, as you go on with experiences, and this has happened in the case of INMARSAT. I mean, INMARSAT is a very young organization; it started with a very small mandate to have earthship stations, and now it is going into land mobile systems, aircraft navigation over the years.

As the technology develops, the treaty is being amended and the functions are evolving.

**PROFESSOR WIRIN**: Carl, we will give you the final word.

**One of the accommodations or compromises that was made in the principles was the acceptance that the data and the information acquired by way of remote sensing are not a national resource**

**DR.CHRISTOL**: Just a word, the term "national sovereignty over natural resources" was used earlier on. This has been a subject which has confronted the United Nations for a long time and it's been a very emotional topic for the developing world, and they're very protective about this. But, it turns out that one of the accommodations or compromises that was made in the principles was the acceptance that the data and the information acquired by way of remote sensing are not a national resource and, consequently, there could be an understanding which was very productive.

**PROFESSOR WIRIN**: I want to remind you that as soon as we reconvene after the luncheon break, that we will be pleased and privileged to hear Greg Fawkes from the Department of Commerce Space Program Office. I'm looking forward to hearing what he has to tell us about the new agency and the way that we will be developing.

# MEDIASAT - RESPONSIBLITY AND NATIONAL SECURITY

*Moderator:*
**Bruce Kopper, Esq.,** Secretary/Treasurer, U.S. Space Foundation

*Speakers:*
**Gregg Fawkes,** Director, Commercial Space Program, U.S. Department of Commerce
**Pierre Bescond,** President, Spot Image
**Gary R. Edwards, Esq.,** General Counsel, EOSAT
**Dr. Ray A. Williamson,** Senior Analyst, U.S. Congress Office of Technology Assessment
**Professor William B. Wirin,** Webster University

**MR. KOPPER**: Good afternoon, ladies and gentlemen. My name is Bruce Kopper, secretary treasurer of the United States Foundation. This afternoon we are going to be talking about Mediasat and some of the legal issues that are involved with Mediasat. Before we get into the specifics, however, it's my pleasure to introduce Mr. Gregg Fawkes, Director of the Office of Commercial Space Programs from the Department of Commerce. It's a great pleasure for us to have Mr. Fawkes here. He's in charge of the formulation of government policy covering the entire range of potential commercial applications in space, and he will start off with a general discussion of this area.

Would you help me welcome Gregg Fawkes.

*MR. GREGG FAWKES is the recently appointed Director of the Office of Commercial Space Programs, in the Office of the Secretary of Commerce. Prior to joining the Department of Commerce, Mr. Fawkes was involved in an effort by a West Coast investment banking firm to establish a venture capital fund for entrepreneurial space companies. He has worked for thirteen years as a consultant in space technology, economics and policy of a wide range including analysis of the technical and economic feasability of remote sensing, communications and solar power satellites. Mr. Fawkes received an A.B. degree in economics from Princeton University.*

**MR. FAWKES**: Thank you very much. I appreciate the opportunity just to make a few informal comments at the beginning.

It's been very interesting for me, as a survivor, at least a partial survivor, of what's been going on in Washington lately to get outside the Beltway, and come here to talk with a very high quality group of people that are serious about space. I've heard a variety of themes underlying these discussions, so the organizers here were kind enough to give me a few minutes to talk generally about the perspective that underlies the new policy decision by the President and how that might reflect on the development of national space activities as the perspective is implemented.

I will avoid the normal Washington address which, as you know, begins with effusive praise for everyone in the room, many people outside the room, and everyone ever related to any of those people. It's probably the fresh air in Colorado Springs that clears out the head. The perspectives are very important in historic proportions. What the new directive on space policy really says is that space has come of age; space is now a place, it is not a program.

**What the new directive on space policy really says is that space has come of age; space is now a place, it is not a program.**

We in fact run several national space programs in parallel on the military side, the intelligence side, and the civil side. On the civil side we've got science, exploration, and operational programs running and those are governmental activities.

In addition, we have a nongovernmental, commercial space sector, that's market-driven. All together the national space programs, plural, in the commercial space activity represent a national space enterprise total. I think it's important to keep in mind the diversity of national interest that we are pursuing in an interesting new place because one should not assume that those interests always sort out in a completely calm, reasonable, orderly fashion.

The situation that we face now, 30 years into the space age, is radically different from the situation we faced when we first entered space. When President Kennedy made that first commitment, when Sputnik first went up, we were shocked, we were taken by surprise, we felt threatened, but we were, in relative terms, a very rich and a very powerful nation which, for the most part, was very confident of its capabilities. The results of the commitments and the drive on the part of the United States in space are well-documented.

**The interests involved in the different sectors sometimes merge nicely and at other times come into a conflict that has to be resolved.**

I think we keep looking back and saying, "Why can't we do that again?" It's very much because of the success of that initial thrust into space that we now face much more complicated questions. We are not doing a singular program, i.e., putting a man on the moon, we are pursuing this wide range of national interests and we are pursuing it in a much more difficult environment. It's a budget-constrained environment. Washington plays it as a zero sum game. One person's success is somebody else's loss.

Even within the space community itself, the various sectors of space are viewed in a competitive fashion - military versus civilian and the like.

The interests involved in the different sectors sometimes merge nicely and at other times come into a conflict that has to be resolved.

The interagency process, which has now been established and which was the vehicle making the recommendations to the President for his new policy directive, represents a normalization of process. In the past, space was often run as a special deal outside the interagency coordination and review process, which is part and parcel of everything else the government does. As such, you ended up with conflict after the fact rather than before the fact.

Some of these potential conflicts among interests and organizations were not sorted out. An example: on the scientific side, there's a strong sense that international cooperation is a desirable thing, that scientific enterprise is based on free exchange of information. On the commercial side, the opposite is true, or not quite the same, I should say. You often see patterns of cooperation, but within a commercial enterprise or toward a commercial end in the control of information; that is, the protection of intellectual and property rights is very, very important. On the defense side you have a similar sort of contraction of distribution of the information or an interest in controlling the distribution of information and you don't necessarily get all those different interests merging together in the same fashion. I think we see examples of that in sorting out the international Space Station negotiations. I think we have to recognize, in approaching space and space policy that we have to resolve the differences that occur when sectors or the interest of sectors rub up against each other.

In the commercial area, with respect to military, Mediasat is an interesting discussion point because on the one hand the military has learned that it's very desirable to have commercial remote sensing data suppliers as essentially a breadth and range of capability that they don't have to pay for except as they use it. On the other hand, there's concern, particularly in the Mediasat situation, about potential national security implications of certain kinds of information running around loose.

So even on the military side you have a balancing. You have a balancing of interests between the U.S. national government, the national security side, and those interested on the commercial side.

If national security restrictions are imposed on our commercial remote sensing operators that render them noncompetitive, then the U.S. industry is at a disadvantage in international competition. That's exactly the kind of sorting out that we are going to see continuing now as we go into implementation.

As you have heard probably every government speaker here say, we do have a national space policy. It's almost like the quotation of Shakespeare, "Me thinks she protesteth too much." Perhaps everybody is saying it convinces somebody. It still isn't there, but in point of fact it's a very solid document. It was the result of a very intense and systematic interagency process. Fifteen agencies sat around the table for the better part of six months, and in the end, that document emerged as largely original work based on the current state of understanding, the different institutional perspectives of all the players, and a careful balancing of all the different national interests involved in space.

Those recommendations were brought forward to the President on a consensus basis and I think that's very important. What it establishes for the first time is a relationship that's clearly defined between governmental space activities - space programs, and industry - the commercial space activities, and it comprises a game plan, a framework, if you will, for an overall national space enterprise.

We now move to implementation, where we have to worry about some of the details not covered or addressed in the original policy process. But I think those now are being sorted out in a reasonable fashion.

As we move into this implementation process, I would just suggest that we keep in mind that there are a variety of national interests, and the name of the game is a balancing of those interests; that there is no one single requirement that we have nationally that outstrips all other national requirements. What we are looking for is a stable, long-term balancing of interests, and that those of us interested in space development need to recognize that those different national space activities are actually mutually supporting or should be conducted in a way that is mutually supporting.

> **Every commercial space operator, from the large aerospace contractors to the most rabid space entrepreneurs, recognizes that their work, their prospective commercial space application, is all based on government research and development activities over the last 30 years.**

Secretary Aldridge has been talking about the critical requirement for bringing down the cost of space transportation. Well, commercial launch services as a new activity is making some very dramatic inroads in exactly that regard; as an example, the beneficial interaction between governmental and commercial interests.

Every commercial space operator, from the large aerospace contractors to the most rabid space entrepreneurs, recognizes that their work, their prospective commercial space application, is all based on government research and development activities over the last 30 years. We have made a substantial national commitment, an investment in capability, and the commercial application is cashing in or getting the payback on that national investment. All commercial space operators recognize the vital role of the government in providing that R & D.

These are just a couple of examples of this continuous progress of interaction among these sectors.

I offer this opposite perspective because I think it's important now, with a policy in place and working through the implementation details, to shift, if we can, the heat-to-light ratio in the discussion or the signal-to-noise ratio; engage in a constructive dialogue, recognize we are balancing national interests, that the various national activities we pursue in space should be organized in a way that is mutually supporting to support an overall national enterprise that is second to none.

I'd be happy to take any questions that are here now; otherwise, we will dive into the Mediasat.

**MR. KOPPER**: Are there any questions?

**PROFESSOR WIRIN**: I would ask a question. Are there some rough edges on the policy that didn't get completely ironed out? And I'm not asking you to necessarily disclose which agencies took which position, but are there some pieces of the policy that may have yet to fall into place that we need to await developments, so to speak?

For instance, Pathfinder, to my way of thinking, sort of kicks the football down the field and gives the team the opportunity to run after it and then decide what they're going to do with it once they get their arms around it.

**MR. FAWKES**: It's important to distinguish two documents that came out in parallel. The President's new directive on National Space Policy was developed through the National Security Council. That is the overarching policy document.

Released at the same time was the President's Commercial Space Initiative developed through the Economic Policy Council of the cabinet in the area of commercial space; in fact, it was the same cast of characters who both brought forth the recommendations and overall policy as well as the detailed implementation initiatives that were recommended to the President.

Pathfinder is an example of a commercial space initiative, a policy point there.

It is consistent with the national policy in noting the importance and expanding human presence in the universe, the importance of the government in advancing research and development and maintaining leadership or pre-eminence in certain key areas. The review of all the options or potential options indicated that there were things that we needed to know before we could make an informed decision or informed recommendations on what the next major goal for the United States should be in space.

So the Pathfinder program is essentially the purchasing of a billion dollars worth of information on how best to do things, certain critical things in space, new things, and the information we gain from that five-year Pathfinder program is intended to support an informed Presidential commitment in the early 1990s to the nation's next goal in space. So it was carefully considered whether to go for a major new goal now or were we in a position to do that, could we make those commitments, did we have the necessary information, and Pathfinder is the attempt to gain the necessary information.

There were a couple other points that, through Washington's time-honored process of leaks to the news media, suggested a certain level of spirited discussion in this interagency process. One of the initiatives was the commercially developed space facility. I believe that one has now been smoothed out rather nicely and is proceeding on track.

**AUDIENCE:** Do you believe that with the department moving ahead, the policy process right now is flawed? In other words, it's policy that guides the DOD and the NASA to move ahead, but it doesn't constrain the legislative branch to fund things. As an example, you've got NASA planning for a Space Station and the Congress slipping it. You've got the DOD planning for ASATs and buying things that the Congress doesn't want to test. And so you can go on and on with examples, but is the policy flawed in that we are directing people to do things that the country as a whole doesn't want to do?

**MR. FAWKES**: I don't think the policy process is flawed. I think what you are talking about is that wonderfully robust and diverse creature called representative democracy at work. I think that only in times of extreme national emergency do you have an absolute uniform commitment to any activity. In times that aren't that extreme I think you get a lot of diversity of opinion, and I think that's, frankly, healthy, but you do have a clear, consistent policy statement at this point in time.

The disputes are on issues of programmatic implementation and they're most often issues on rate of development or rate of commitment to programs rather than whether or not the program should be done.

**AUDIENCE**: But I guess all I'm saying is, I like the word "policy"—the programs to become policy in this country.

**MR. FAWKES**: Well, you put your finger on something that's very important. We ended up with a real inversion process where money controls programs and then based on what you're doing programmatically, you can infer what the policy is. We are trying to turn that around and lead with a very consistent, carefully thought-through policy and then implement that through programmatic decisions. Then that tells you where the money is spent.

It's a little bit hard to fully effect that in a Gramm-Rudman environment because there is an absolute cap on funding.

**AUDIENCE**: But I'm saying you shouldn't even have programs listed as a policy. CBSF or Space Station is a program.

**MR. FAWKES**: There are no programs referenced in the policy document, period. The commercial space initiative lists 15 policy implementation initiatives consistent with the national policy.

**MR. KOPPER**: Let's give Director Fawkes a hand.

Before I introduce the panel, there is one member of the audience that I would like to have you recognize. Astronaut Buzz Aldrin, who is a great friend of the United States Space Foundation and, of course, still very interested in space. Would you please stand.

At this time I would like to introduce the panel. On my far right, on your left, Gary Edwards is general counsel for the Earth Observation Satellite (EOSAT), a position he has held since 1986.

He practiced law with the firm of Reagan & Mason, Washington, D.C., in which he was a partner. He received his Bachelor of Science degree in electrical engineering from Purdue and a juris doctor from Georgetown University. He is a member of the American Bar Association, the International Bar Association, and the International Institute of Space Law.

Let's welcome Gary Edwards. Sitting next to him is an old friend, Bill Wirin, USAF (Ret) who was the staff Judge Advocate Space Command here in Colorado Springs for many years. A professor at Webster University, he chaired both panels this morning and I'm sure he's well known to all of you.

Next to him is Director Fawkes who just spoke, and next to him is Ray Williamson. Ray is a senior analyst in the Office of Technology Assessment for Congress. He's been a project director of many space programs and a contributing editor of the Journal of Space Policy. He writes extensively on space policy issues. It's a great pleasure for us to have you with us today.

Finally, on my right is Pierre Bescond, the president of SPOT Image Corporation. He is now living in this country and has had extensive satellite experience throughout the world. He was the director for the operation of satellite systems at Centre National d'Etudes Spatiales, the French space agency in Toulouse, France. He served as both executive director and technical director of the Ariane Rocket Launch Center in French Guiana.

It is indeed a pleasure for us to have you here on our panel.

We'd like to start off with Mr. Bescond, and would you please take the podium.

**MR. BESCOND**: Thank you, Bruce. What I would like to do this afternoon is introduce you to how SPOT pertains to the media and, as we shall see, probably even more than the media, arms control verification, perhaps.

The way I want to show this is to be very pragmatic. I am going to talk about facts. So in the first part I would recall the characteristics of SPOT because there are sometimes some misunderstandings about what SPOT can do and what it cannot do.

In the second part, I can show how this pertains again to media use of the remote sensing data.

In the third part I will show examples of slides which are taken out of the data from SPOT.

*PIERRE BESCOND assumed the presidency of SPOT Image Corporation on September 1, 1986. Beginning in 1982, until he joined the U.S. SPOT Image Corporation, Mr. Bescond was the Director for Operation of Satellite Systems at Centre National d'Etudes Spatiales (CNES), the French space agency, in Toulouse, France. As Director, he was responsible for implementation of the SPOT satellite system's primary ground receiving stations and the mission control and image processing centers. He also worked on several cooperative satellite programs with U.S. agencies including NASA and NOAA. Mr. Bescond has also served as both Executive Director (1980-1982) and Technical Director (1977-1980) of the Ariane rocket launch center in Kourou, French Guiana, from which SPOT 1 and many international satellites have been launched. Other technical and research experience includes work with optical systems, computerized photoprocessing, space telemetry and rocket technology, all of which are essential components of the SPOT satellite system. Mr. Bescond's education includes degrees from Ecole Polytechnique, France's leading school for science, and Ecole Nationale Superieure de l'Aeronautique, France's leading school for space and aeronautics science. He has also been a member of several international committees devoted to developing space technology.*

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I would just point out those characteristics that are important for our debate of this afternoon.

The satellite is orbiting at 517 miles and it's a sun synchronous orbit. The orbital cycle is 26 days, which means that it goes over the same place every 26 days, but it has a steerable mirror which means that the revisit capability under our latitudes is of the order of four to five days.

It's a multilinear array detector pushbroom scanning technique, two instruments, two telescopes on board. The scene from SPOT, which is the basic data set that we sell, is 60 kilometers by 60 kilometers; the two HRVs, the instruments making two of these scenes in parallel along the track.

The transmission is made directly to receiving stations where they are in view of the satellite, or we tape-record the data on board and they're then dumped into the Toulouse and Kiruna stations in Europe if the data, when it is acquired, is not in view of a direct receiving station.

The bands were chosen as a compromise between technical and commercial needs. We only have in the multispectral mode three bands because these were recognized to be those basically necessary for addressing the market that we sold.

The panchromatic mode is a black and white mode with a wide band. The difference in resolution is 10 meters for the panchromatic and 20 meters for the multispectral, and we shall see that the 10 meters is more significant than the other in terms of the media.

Some products that are available from SPOT Image include radiometric and/or geometric corrections and the basic data that we sell is on CCT, computer compatible tapes.

Ray Williamson this morning showed why the digital were important to go through the computers. We also sell transparencies or photo prints. These are the photo products derived from our data.

SPOT is committed to implementing a long-term system. SPOT I has been launched. It has been in orbit now for two years. It was designed for two years in orbit, and has exceeded that already. We expect it to last three years, maybe more.

SPOT II is built and waiting for launch. SPOT III is under construction, and SPOT IV, which will include a few new technical advancements, is under phase B design.

SPOT IV will include a mid-infrared band. It will also have a self-contained package, but we will not talk about this one because it's not relevant to Mediasat.

**SPOT has the highest resolution available from a civilian satellite, 10 meters.**

What is not in here, despite what has been published sometimes, is 5-meter sensors. We do not have any plans for a 5-meter sensor at this stage, and maybe you want to discuss this later on. We do not see a market for this so far.

SPOT is a worldwide system. In addition to the tape recorder, we have a number of stations receiving operationally today. Seven are receiving and we are planning another set of stations which should open starting now, probably another six to seven in '88 and maybe a few more in '89.

To sum up, and this will be relevant to the media discussion we want to have today, SPOT has the highest resolution available from a civilian satellite, 10 meters. It allows stereoscopic image production thanks to its steerable mirror. It has a rapid revisit capability which also is interesting for the media, and a users-oriented technology to facilitate marketing. It's a commercially distributed data system, and this is very important in the sense that we do abide by the open sky, open access principles of the United Nations which were again discussed at length this morning.

One often forgets about open access, (the resolution in actual fact says open skies) which means that anyone can make pictures of any where on the earth provided he's ready to provide this data to anyone who wants to buy it. This is open access under reasonable conditions, of course. So that opened the way for commercial distribution of this data.

Now, I would like to give a set of definitions before we go further on the resolution. The resolution has been defined this morning. This is the smallest item you can see on the ground, and as we said, on SPOT we can do 10 meters.

Now, for further reference I will define "detection" as being able to see the presence of an object. To "recognize" the object would be to determine the type of object that we are looking at. For example, we should be able to say this is a building or it's an airplane or it's a vehicle.

Now, it's not necessarily "identified" when you have recognized it. To identify it, you would need to recognize the object as being, in the case of a building, either a farmhouse or a set of offices; in the case of an aircraft, is it a Boeing 747 or is it a fighter?

If you want to "describe" the object that you are seeing on the image, then you want to be able to analyze the identified object which means recognize some details on it and maybe more than that.

Now, with what I have said and the 10 meters resolution from SPOT, this is what it needs in terms of size on the ground to make sure that you detect the object. The object would have to have a size of 10 to 30 meters square, let's say, but it may be lengthy. It depends on the condition of the sun's reflections and this kind of thing, but, basically, there is nothing you could detect below 10 meters unless it is very shining object, such as a light, for example, but you would not then be able to recognize it.

For the object to be recognized at 10 meter resolution, the object would have to be 20 to 60 meters in length at least. To be identified, it would have to be 60 to 180 meters, and to be described, it would need to be 200 to 600 meters. So as you can see, you would probably not be able to describe an aircraft. You would probably be able to start describing a big ship, maybe.

If you used stereoscopic data, then the object size that you need to do these various works on the data is cut by one-half, roughly, because then you would discriminate with the altitude that you can derive from the stereo set.

There is one new satellite under development which is the French Helios reconnaissance satellite.

In the media, about two months ago, a metric size was publicized, which suggested that Helios might be the one meter type of resolution. But, again, I don't know.

**We had not anticipated news media nor arms control verification to be customers of SPOT. This was not in our initial marketing studies.**

What I am conveying here is that SPOT is really bridging the gap between the LANDSAT type of data and the military satellites. It was a decision that we would not go beyond the 10 meters resolution because, first, this was enough for the market that we were anticipating and, second, it clearly had implications on the military side if we were going further down than 10 meters resolution. So we decided we would stay at 10 meters. Among some of our new and developing applications, are arms control verification, for which we now have some customers, at least, to assess the validity of our data for their works, and we do have the news media, so to our customers this is a fact. They are buying our data for that purpose.

And, by the way, we had not anticipated news media nor arms control verification to be customers of SPOT. This was not in our initial marketing studies. We did not see them and they came to us.

I would now like to further comment on this through examples with slides.

The first two images will illustrate the interest of quick revisit capability. This picture was taken in the south of France, a blazing fire, which happens every summer, and we were asked to take this picture as soon as possible and we were lucky enough to do this the next day we were asked and the fire was still blazing.

Three days later — we made a picture of what happened, what was the extent of the disaster. Of course, it has a number of applications, but it does have interest, I guess, for the media, what a good illustration for a media story on the forest fire in the south of France.

This is a multispectral data enlargement, this is about 9 kilometers wide and five kilometers high of part of the Florida Keys, just to show what the multispectral data can give you, including under water. The environmental use of this is quite obvious for the channels below water as well as circulation of water.

This is a standard picture of New York which is the full scene, 60 kilometers by 60 kilometers, and this is 20 meters resolution. This one was used by news media on the anniversary, 4th of July, 1986. It was extensively used by the media this time. It was one of the first bought by the media.

Now, if we want to go further on the urban areas, this is Washington, D.C., with a 10 meters resolution. Here what we have done is merge the 10 meters resolution data from panchromatic data and the 20 meters resolution on multispectral. It also is a mosaic of four different scenes. In all there are 8 scenes, four multispectral and four panchromatic, and they were made in March of last year. This has been processed by the Environmental Research Institute of Michigan.

Now, downtown this is what you can have, and you can see the level of detail that you have here which is really similar to some kind of aerial photography. We start to have the resolution of some aerial photography.

Again, in the urban area, this is Phoenix, Arizona, and this is a zoom on Sun City, which is a retired people village, I understand. You can count the houses there.

The next one is perhaps more interesting. This is on the same scene and this is Phoenix airport. On this one you can see the airplanes. I would not be able to say what kind of airplanes they are. Maybe an expert — a military interpreter, might be able to say this by analyzing the various forms, the shapes of the wings that you can start to see, but I'm not too sure.

This is to illustrate the 3-D work that you can do with SPOT data. In actual fact, this was not derived from SPOT, it was draping an existing terrain model with multispectral data from SPOT. But with stereoscopic images from SPOT, you can derive the terrain model, and that has a number of applications. If you want to put these in motion, and the media have used this, ABC for the Calgary Olympics have used that, they were supposedly flying from Calgary City to the ski tracks and that was a shot that was made with SPOT data. They had a value-added firm that created the terrain model and then worked through the terrain model in the computers to have this flyover into the valley and to the ski tracks.

This is the first exposure of SPOT data to the media, the Chernobyl nuclear accident, which is well known. The great interest of this exposure of Chernobyl by both LANDSAT and SPOT was that eventually the Soviets released a tremendous amount of information about what happened at Chernobyl. I'm told that the report that they eventually gave to the press in Geneva, was probably the most comprehensive report on such an incident that was ever produced.

Now, this is a desert. There's nothing more — nothing that you can do about this except if you zoom in the square here. This is the Libyan Desert and it does show a good deal of military activity down there. I guess any media that would like to make a good story about building up the military installations in the south of Libya close to the border of Chad could, of course, use that.

This is the Persian Gulf. Again, nothing particular here except if you zoom in, and this has just been taken the day after a raid from the Iranian forces into Iraq. This is an oil facility. The Iranian Air Force claimed they had destroyed the whole facility. The Iraqis said that no damage had happened. You have here not ground truth but some truth through remote sensing. We can see that at least three tankers were hit. Maybe we cannot say more. I guess we can say more. Some of the tankers are destroyed. You have black spots which are obviously black puddles of oil and there are still some white spots which may be operating tankers, but we don't know. But at least you can tell both countries that they lied, there was some damage.

This is again the Persian Gulf and it's a loading facility for oil. This is what we can see, not much activity here. No tankers left. I guess that could be the start of a story. It doesn't prove anything, again, but for a media story to expose to the public what the governments do not want to expose, what is best is that which is commercially available, independently available.

**MR. KOPPER**: Pierre, do you have the ability to zoom down from the satellite or how do you get the resolution?

**MR. BESCOND**: No, the information is all in here, in the scene. The zooming is ground computer. If you want to zoom up to enlarge, you manipulate digitally the image. The satellite doesn't zoom in — that's the wrong term if this is the way you understood it.

Another military activity and this is Algeria, near the Moroccan border, the Tindouf Airport. If you want to fly there, let's say you're a private pilot with your own aircraft, this is a sketch which was drawn from the available information and this is what you would have. This is what the SPOT pictures give. There are considerable changes and this is a sketch which was made from the SPOT image. It has clearly been built into a military airfield and in actual fact one of the old runways has disappeared. It had a cross there, it has disappeared.

This is not a very nice picture, but I show this one because it's Pechora radar, anti-ATBM radar. This is not the one that was exposed. The one that was exposed was the Krasnoiarsk, and as you well know, Congressmen from the U.S., after we exposed the Krasnoiarsk radar through ABC, networks were invited to view the facilities. We understood afterwards that Vice President Bush made a declaration that now that we had seen images of Krasnoiarsk, it may be one way for Secretary Gorbachev to prove that he was serious into announcing his Glasnost was to admit that there was SDI work somewhere, and it was admitted by Gorbachev later on that there was some kind of SDI work in the USSR.

Now, to conclude on a nicer note, this is a very nice picture of the desert, Gibson Desert in Australia, which in actual fact has been used by nations very recently to illustrate what remote sensing could show. That's a very nice picture. It has a number of applications in geology and other types of applications, but also has value as a very nice picture. What I would like to say before I conclude is that the big merit that this kind of data has is that it does expose the public (and this is what the media tried to do), to independent sources of information. This does it, and it does it to a level of detail that no one has shown so far.

Another good story is about the Semipalatinsk facility in the USSR again, and it also illustrates the danger of misinterpreting the data. Our data was bought by a firm which was created just to do this kind of things, Space Media Networks, in Sweden. An expert — I don't know what he found — claimed it showed that the Soviets would resume underground testing of nuclear bombs. And then the answer from the Soviets was that they invited the western European journalists to visit the area. Excellent. They were received by a congenial general who explained what he could show, and he said, "But you'd better be careful because when you show your images, you'd better interpret them nicely." There is no shaft for the testing that you can see here. The circles that you can see in your imagery are just measurement devices. I shall now show you the shafts where the tested equipment is put through, and they were horizontal. There was a cliff and they were cut on the cliff, so they were entering horizontally. There was no way you could see them on the picture. So it does illustrate the danger of misinterpreting this data.

My conclusion will be that we believe SPOT is adapted for use by the media of the data, 10 meters resolution. It probably is a good tool to illustrate the stories. It is not proof in most of the cases of what the media tried to prove.

I told Mark Brender from ABC that there was no tactical use. There is good strategic use, obviously, of this data. I don't think there is tactical use because the 10 meters resolution is not enough and also because we cannot deliver real time data. The system is not built for delivering real time data.

And Mark Brender said, "Well, Pierre, what you call tactical use for the media is news."

Then he said that the media should go further and get their own news satellite. This is how he started involving the Mediasat concept and this is how we later on heard more about the 5 meters use from the media, and I guess we will hear more about this later on. But, as I say, we do not address this. We stay at 10 meters, which is enough for our market.

Thank you very much.

**MR. KOPPER**: Thank you, Pierre, for a most interesting talk.

Our next speaker will be Gary Edwards of EOSAT.

**MR. EDWARDS:** Thank you, Bruce. It's a pleasure for me to be here this afternoon on behalf of EOSAT and to be able to talk with you for a few minutes about this most important question of the relationship between Mediasat, the first amendment, and national security.

For those of you who may not have been terribly familiar with what land remote sensing is all about, I think having seen Pierre's presentation, you can get a little bit better idea of what the issues really are as they relate to the national security implications of land remote sensing and the first amendment.

For those of you who may not be familiar with my company, EOSAT, I'd like to take a few minutes to tell you about EOSAT and about the LANDSAT program.

*GARY R. EDWARDS is General Counsel for Earth Observation Satellite Company, (EOSAT) a position which he has held since 1986. For 14 years prior to that he practiced law in Washington, D.C. where he was a partner with the law firm of Ragan & Wason. Mr. Edwards received a Bachelor of Science degree in electrical engineering from Purdue University in 1967, and a Juris Doctorem degree from the Georgetown University Law Center in 1971. He is a member of the American Bar Association, the International Bar Association and the International Institute of Space Law, IAF.*

EOSAT is a joint venture partnership between Hughes Aircraft Company and the General Electric Company. We are a private enterprise. Under a contract with the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, we operate the LANDSAT system, which is a United States government-owned land remote sensing satellite system. Under the terms of our contract, as authorized by the Land Remote Sensing Commercialization Act of 1984, our mission is to transform the LANDSAT system from a government program to a viable commercial entity.

**During the late '70s, though, it became clear that the system had great potential for commercial development and that such development could best be accomplished by the transfer of the system to the private sector.**

My comments this afternoon, then, are based on EOSAT's perspective as a potential provider of remotely sensed data for use by the media.

The LANDSAT system has been in operation since 1972. It was developed initially by the National Aeronautics and Space Administration as an experimental program. During the late '70s, though, it became clear that the system had great potential for commercial development and that such development could best be accomplished by the transfer of the system to the private sector.

In 1979, the Carter administration commenced the transfer of the system from NASA to the National Oceanic and Atmospheric Administration, Department of Commerce, and announced its intention to transfer the system ultimately to a private commercial operation. This policy was continued by the current administration, and in 1984, with administration support, Congress adopted the Commercialization Act, to which I just referred, which authorized a gradual transition of the program to private operation over a ten-year period.

This transition is to be accomplished in two phases: The first phase calls for the operation of the existing system which consists of the satellites LANDSATs 4 and 5, which are still up there and operating, and for the marketing of data generated by the system. The second phase calls for the development of a follow-on system, including additional spacecraft and associated ground station to be deployed in the future, and for the marketing of the data from that follow-on system as well. EOSAT was the successful bidder for both phases and executed a contract with the Department of Commerce on September 27, 1985.

If there are any of you in the audience who are familiar with the history of our efforts since that time, then I am sure you will appreciate that it gives me a great deal of pleasure, and no small amount of relief, to confirm to you this afternoon that the LANDSAT program is moving forward once more. After a hiatus of more than a year, during which no monies were available for the development or construction of the spacecraft, sensor, and the ground system which were necessary for the continuation of this important program, we have now received contract funding from the Department of Commerce, and the major subcontracts have been reactivated. The development of LANDSAT 6, therefore, is in full swing again. LANDSAT 6 is, as you may recall, is the successor to LANDSAT 4 and 5 which currently operational.

**It gives me a great deal of pleasure, and no small amount of relief, to confirm to you this afternoon that the LANDSAT program is moving forward once more.**

This gratifying progress is the result of EOSAT's success in reaching agreement with the Commerce Department on the terms of an overall restructure of the LANDSAT program to accommodate the need for an ELV launch, that is, a launch or an expendable launch vehicle, and also to fit within the government's new funding constraints that we have heard a lot about in these last couple of days. As required by the terms of our appropriation, the new agreement, which provides for a substantial capital investment by the two partners in EOSAT, the General Electric Company and Hughes Aircraft Company, was approved by the House and Senate appropriations subcommittees on March 31 and the revised contract executed on April 1. We have now signed a funding modification, and some $62.5 million has been allocated for the continuation of the program. We expect another $10 million rather shortly, and we are, needless to say, very pleased about that.

Under the terms of our revised contract, the LANDSAT program calls for the construction of LANDSAT 6 in time for a launch in early 1991. The spacecraft will be derived from the highly successful TIROS N and DMSP meteorological satellite designs, and will carry an improved version of the Thematic Mapper instrument currently aboard LANDSATs 4 and 5. The new instrument, known as an Enhanced Thematic Mapper, will provide a 15-meter panchromatic sensing capability as well as the 7 basic multispectral bands that are currently carried by LANDSAT 4 and 5.

In addition, EOSAT is working with NASA and with the Navy on the terms of an agreement to place a wide-field ocean color imager known as Sea-WIFS aboard LANDSAT 6 and is also exploring the technical and economic feasibility of incorporating a new high- resolution sensor known as STAR, which I will mention in a few minutes. As a part of the restructure of the LANDSAT program, the Commerce Department is also conducting a study of ways to improve the technological and economic competitiveness of LANDSAT 7 and is considering alternative means of financing its construction. Contracts for these studies were let in early March and the results are due this summer.

**There is a substantial interest among the user community in a high resolution data set which would provide more frequent coverage than is currently available from any existing space-based civil remote sensing system.**

Because of our belief that a highly competitive LANDSAT 7 will pave the way for fully commercial LANDSAT 8 and subsequent generations of spacecraft as well, and due to our commitment to the commercialization of LANDSAT, in August 1987 EOSAT commenced its own study of the technical and commercial factors that will shape that spacecraft. Our study is based on a dozen user surveys, market assessments, and working groups conducted over a period of about 24 months. It is designed to identify data sets that would be of the greatest utility to the user community.

Of particular significance for the purpose of our discussion this afternoon, our study indicates that there is a substantial interest among the user community in a high resolution data set which would provide more frequent coverage than is currently available from any existing space-based civil remote sensing system. Based on this information, EOSAT has developed a design for such a sensor which we have nicknamed STAR, which is an acronymn for Satellite Tracking and Reporting sensor. This new sensor would provide 5-meter multispectral coverage in 3 bands of the visible spectrum, that is, red, blue, and green. Although the swath width of this sensor would be relatively narrow, its cross-track pointing capability would allow repeat coverage of discrete locations throughout the world on a daily basis. While the principal focus of our attention for this instrument thus far has been on LANDSAT 7, EOSAT is, as I mentioned earlier, currently exploring the possibility of placing an experimental version of the instrument aboard LANDSAT 6 as well. This brings me to the point of the discussion this afternoon.

This prospect of such advancements in the state of the art in the civil remote sensing industry, including in particular the advent of new higher resolution sensors, has been the focus of considerable controversy over the past several years. On the one hand there are those who are concerned that the operation of advanced civil remote sensing systems, especially by a private commercial entity such as EOSAT, will have a destabilizing effect on world affairs that would jeopardize our national security, complicate the conduct of international relations, and generally reduce the degree of privacy which we, as Americans, have come to cherish and to expect. On the other hand, the same advances have heightened concerns among the media that they may result in the imposition of new restraints on news-gathering and reporting activities of the press in a manner which is inimical to the First Amendment guarantees that are fundamental to our free society. These issues and these concerns are, to state the obvious, matters of extreme importance, not only to those involved in remote sensing, such as ourselves and the media, but for all those who seek security in their freedom.

EOSAT for its part, however, does not regard that its role in this controversy is to become an advocate for one side or the other; rather, our perspective is, as I mentioned earlier, shaped entirely by our mission, which is to commercialize the LANDSAT remote sensing system. We therefore view the matter of high-resolution advanced technology sensors primarily as a business challenge, that is, how best to develop such technology in a manner that will return a profit and contribute to the development of a commercially viable remote sensing industry.

Our approach in this regard is not premised principally on legal or political considerations but, rather, on pragmatics. Our colleagues at SPOT Image have offered 10-meter data since early in 1976. The Russians are already offering 5-meter data, and there's no reason to doubt that as the applications and sensor technology advances, additional systems will be developed and deployed.

**No amount of regulation by the United States Government is likely to prevent the advance of remote sensing technology in the long run and, therefore, the only real question is whether the United States will participate competitively.**

The President's recent rescission of the reported 10-meter limit on the resolution of U.S. space-based civil remote sensing systems reflects, in our view, a recognition of the simple fact that no amount of regulation by the United States Government is likely to prevent the advance of remote sensing technology in the long run and, therefore, the only real question is whether the United States will participate competitively. The President's action simply opened the way for U.S. operators to compete on an equal footing with systems which were already being developed and deployed in other countries. Whatever legal and regulatory constraints may ultimately result from the present dialogue, therefore, EOSAT is confident that they will leave ample latitude to satisfy the demand of remote sensing commercialization and will be consistent with the dictates of national security and freedom of the press as well. This is simply a process which, by its nature, requires time. It cannot and should not be hurried.

At this point, I will leave the political and constitutional debate to the political experts and the constitutional scholars, of which I am neither, and focus briefly on an aspect of the Land Remote Sensing Commercialization Act, which, as General Counsel for EOSAT, I have become intimately familiar and which is of substantial significance to the press and those who are involved in news-gathering as well. I am referring now to the nondiscriminatory access to data requirement of the Commercialization Act.

Section 601 of the act provides that unenhanced data generated by a system operator must be made available to all users on a nondiscriminatory basis at prices and upon such terms and conditions as are made publicly available under Section 602(b) of the act. This requirement is repeated in Section 202 of the act which is applicable to us as the operator and contractor for the marketing LANDSAT 4 and 5 data; Section 304 of the act, which is applicable to us as the Title III contractor to develop new spacecraft, and Section 402, which is applicable to us as a prospective licensee under Title IV of the act.

The nondiscriminatory access requirement is, as we heard this morning, an element of a broader doctrine known as the open skies policy which has been a part of U.S. foreign policy for more than 30 years. You have heard a good deal about the background of that policy this morning, and although I had incorporated a healthy dose of it in my paper, I won't bore you by repeating it other than to say that the nondiscriminatory access requirement itself is a corollary of the open skies policy, which preserves for the United States a favorable position with respect to those countries who advocate a prior consent requirement.

In view of its background and purpose, therefore, enlightened self-interest dictates that commercial operators such as EOSAT adhere faithfully to the principle of nondiscriminatory access to data and that, indeed, has been EOSAT's policy since its very beginnings.

Does this mean that LANDSAT data will be less useful for news-gathering and reporting purposes? EOSAT certainly does not believe that it must or, indeed, that it will.

In its simplest terms, nondiscriminatory access to data means that the data must be offered to everyone on the same terms and conditions and that such terms and conditions must be published so that their availability is known to all. Thus, for example, EOSAT may not, consistent with that statute, refuse to sell to a particular customer or strike a special secret deal with a preferred customer or class of customers. Similarly, it may not give one customer or class of customers access to LANDSAT data which is not offered to other purchasers or potential purchasers under similar circumstances.

While in its minutest detail and carried, as we say, to its illogical extreme, the application of the nondiscriminatory access principle can create some rather incongruous results. In EOSAT's view, the ultimate standard which should be adhered to is a subjective one of equity and fairness. In the last analysis, in other words, nondiscriminatory access is primarily a matter of good faith. EOSAT must deal with its customers in a manner that does not place any one customer or group of them or any country at a disadvantage vis-a-vis another customer, group of customers, or country. Viewed in this light, many of the seemingly difficult problems become far less difficult.

By its acceptance of the mission of commercializing LANDSAT, as provided in the act, EOSAT has also accepted the challenge or, as we frequently refer to it, of the "opportunity to excel," of finding ways to satisfy the commercial needs of our customers, including the media, without doing violence to the acts of nondiscriminatory access provisions. This balancing or equitable approach to the nondiscriminatory access requirement is amply supported, in my view, by the Commercialization Act and its legislative history, as well as by EOSAT's contract to the Department of Commerce which provides expressly that the contractor is "free to use its own business judgment" in making marketing decisions.

The contractual language is amplified in the legislative history which makes it clear, among other things, that the act was intended to provide the operator with "certain flexibilities commonly available to commercial entities"; that the operator is expected to expand the market for remotely sensed data by aggressively marketing the data on a commercial basis; that the operator is permitted to offer "various terms of access at various prices," provided only that they are published and uniformly available; and, finally and specifically, that the operator is permitted to offer varying terms of delivery.

**There would appear to be no reason in principle why we cannot offer LANDSAT data on a subscription basis, a possibility, by the way, which EOSAT is currently considering.**

Taken collectively, these principles appear to provide EOSAT with ample latitude as a commercial marketeer of LANDSAT data to develop new ways to provide our customers with access to such data in a manner which satisfies the demands of their particular lines of business. For example, there would appear to be no reason in principle why we cannot offer LANDSAT data on a subscription basis, a possibility, by the way, which EOSAT is currently considering.

We can also offer watching services, including geographic packages and specials, and in order to satisfy the needs of our customers for more timely access, we could develop new programs, modes, and procedures for priority delivery of data and offer the data in unprocessed form on high-density tapes or in other media. One such medium that's been mentioned is digital disks. That technology exists, but I understand that standards have not been adopted, and at this time it doesn't appear feasible. We would certainly like to explore that in the future, however. We have also, by the way, recently introduced a small scene on floppy disk, which is suitable for PC processing and is very highly useful for those involved in geographic information systems. These, of course, are but a few examples.

In the final analysis, we believe that our ability as a commercial operator of the LANDSAT system to satisfy the commercial needs of our customers, including the media, while at the same time observing the nondiscriminatory access requirement of the Commercialization Act is limited principally by our own imagination, creativity, and ingenuity in developing and offering new products and services and new modes of delivery. This, we believe, is the essence of commercialization.

Thank you very much.

**MR. KOPPER**: Thank you very much, Gary. Our next speaker will be Dr. Ray Williamson.

*DR. RAY A. WILLIAMSON is a Senior Associate in the Office of Technology Assessment (OTA) of the U.S. Congress, Dr. Williamson was Project Director of the space policy assessments, International Cooperation and Competition in Civilian Space Activities (1958), Civilian Space Policy and Applications (1982), and Solar Power Satellites (1981). He recently completed a study for OTA entitled "Reducing Launch Operations Costs: New Technologies and Practices." Dr. Williamson is a contributing editor to* ***"Space Policy"*** *and writes extensively on space Policy issues.*

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**DR. WILLIAMSON**: What I put together here is a list of some of the milestones for civilian remote sensing.

CIVILIAN REMOTE SENSING MILESTONES

| | |
|---|---|
| 1960 - | TIROS LAUNCHED |
| 1972 - | NASA ERTS PROGRAM |
| 1975 - | NASA LANDSAT PROGRAM |
| 1978 - | CARTER DIRECTS DOC TO STUDY COMMERCIALIZATION |
| 1981 - | REAGAN ACCELERATES TRANSFER TO PRIVATE SECTOR |
| 1984 - | TRANSFER OF LANDSAT TO NOAA COMPLETE |
| 1984 - | LANDSAT ACT SIGNED INTO LAW |
| 1984 - | COMMERCE RELEASES RFP TO PRIVATE SECTOR |
| 1984 - | EOSAT CONTRACT |
| 1985 - | SPOT IMAGE (France) |
| 1986 - | SPACE MEDIA NETWORK (Sweden) |
| 1988 - | REAGAN ENCOURAGES PRIVATE REMOTE SENSING |

Other people might choose a different list, but one of the things I wanted to say with this list is that news-gathering from space is just one of many uses of remote sensing. We really have to see news-gathering or Mediasat in the context of the total market.

The second transparency gives a partial list of some of the media uses of remotely sensed images for television news. The third lists uses for some of the newspapers and magazines.

*RECENT PRESS USE OF REMOTE IMAGES*

*Television news*

| *Date* | *Event* |
|---|---|
| *April 1985* | *Iran/Iraq border area--ABC.* |
| *January 1986* | *Libyan military airfield and SA-5 sites--ABC.* |
| *February 1986* | *Naval facility at Murmansk--ABC.* |
| *April 1986* | *Chernobyl nuclear plant--all networks.* |
| *July 1986* | *New York City harbor--ABC.* |
| *July 1986* | *Soviet nuclear testing facility at Semipalatinsk some 1800 miles southeast of Moscow--ABC, CBS, CNN.* |
| *August 1986* | *Soviet shuttle facility at Tyuratam in central USSR--ABC.* |
| *October 1986* | *Soviet Submarine base at Gremikha--Swedish televison.* |
| *January 1987* | *Iran/Iraq war--ABC* |
| *April 1987* | *Soviet radar facility near Krasnoyarsk--ABC.* |

*Newspapers, magazines*

| | |
|---|---|
| *March 1986* | *Libian SA-5 sites and military bases--New York Post* |
| *April, May 1986* | *Chernobyl nuclear plant--many newspapers, magazines* |
| *September 1986* | *U.S.S.R. Kola Peninsula--Jane's Defense Weekly* |
| *October 1986* | *Soviet cosmodromes at Plesetsk and Baikonur--National Geographic.* |
| *March 1987* | *Soviet Navy base at Murmansk and Soviet Air Force base at Severomorsk--Aviation Week and Space Technology.* |
| *March 1987* | *Pakistani nuclear processing facility--London Sunday Observer* |
| *July 1987* | *Soviet Nuclear Submarine Base on Barents Sea--Aviation Week and Space Technology* |

The fourth transparency presents the Mediasat con-

The Mediasat Concept

- HIGH SPATIAL RESOLUTION
  - 5 M or less
- TIMELY GLOBAL COVERAGE
  - Daily Coverage or Better
- CONTROL OVER SYSTEM AND PRODUCT
  - No U.S. Government Interference
  - No Foreign Interference

cept. Here, roughly, is the kind of capability we're talking about, reasonably high spatial resolution, 5 meters or less, timely global coverage. Daily coverage would be wonderful if the cost were such that you could do it. The Mediasat owner would also need control over system and product. In other words, from the U.S. standpoint, no U.S. Government interference and also no foreign interference.

The Mediasat concept raises a number of basic questions, which are illustrated in the next transparency. We had a workshop at OTA about a year and a half ago on this subject and those of us who had been involved in looking at the policy of remote sensing for a while experienced considerable deja-vu, because many of the things that were dealt with by the media experts and by the remote sensing technical experts we had heard before in discussing the question of commercializing LANDSAT. Was there going to be government interference in increasingly high resolution? Would there be any limits on the use of the data and so forth.

As you look at this list, you see that there is a question of the status of the remote sensing industry as a whole and as to whether it's a viable industry. You have heard from two gentlemen this morning and afternoon who have pointed out that they're selling data at, if not a comfortable rate, at least a growing rate, and we see the general market, for the remote sensing industry built over time. The question is, can the industry provide the timely access and the daily coverage that we'd need for Mediasat?

*MEDIASAT RE-RAISES BASIC QUESTIONS*

- *STATUS OF REMOTE SENSING INDUSTRY*
- *MARKET FOR MEDIASAT DATA*
- *MARKET FOR ALL REMOTELY SENSED DATA*
- *HEALTH OF CIVILIAN SPACE INDUSTRY*
  - *-REMOTE SENSING ONLY SMALL PART OF SPACE INDUSTRY*
  - *-HEALTH OF OTHER PARTS EXTREMELY IMPORTANT*

Then, as a subset of the total remote sensing industry we see the question of the market for Mediasat data themselves. One of the points that often gets glossed over is that if you are talking about data that is 5 meters resolution, it doesn't take very many passes of that satellite before you are engulfed in data. So two of the issues that we will have as we go along is what to keep and what to save and whether or not there is a large enough market for the data by the media.

I have already mentioned in part the market for all remotely sensed data and said that that is building. That is related to the question of the health of the civilian space industry of which remote sensing is only one small part. The health of those other parts of the space industry is very important. For instance, will the costs for launching Mediasat-type satellites into space go low enough so that the cost of the launch is a much smaller proportion of the total outlay for that purpose?

We also face the question of government versus private ownership. We now have a policy in place that is promoting private ownership of remote sensing, but I can tell you from having had long conversations over many years with many various government officials that there is a strong undercurrent of interest in having a government-run, government-financed, government system for remote sensing to operate as a public good.

The next slide presents some of the market determinants. This is probably not an exhaustive list, but one of the first things we see is market uncertainties. Those uncertainties inhibit potential financing Mediasat and other remote sensing, and they also tend to inhibit, for the same reason, market development.

*MARKET DETERMINANTS*

- *MARKET UNCERTAINTIES*
  - *-INHIBIT FINANCING*
  - *-INHIBIT MARKET DEVELOPMENT*
- *COST OF DATA*
  - *-AUXILIARY MARKET*
- *THE DEMAND FOR "MEDIA-QUALITY" IMAGES*
- *US AND FOREIGN GOVERNMENT POLICIES*
  - *-COLLECTION*
  - *-DISTRIBUTION*
  - *-POLICY UNCERTAINTY*

The cost of data is high. In the case of the Mediasat, one of the things that some people have begun to explore is the nature and size of the auxiliary markets for those data to bring down the cost of an image for each media use.

Another market determinant is the demand for media quality images.

Finally, the issues which tie back to the question of market uncertainties are U.S. and foreign government policies over collection, distribution, and, of course, the overall policy uncertainty.

> **The policy that we have today — to encourage development of a U.S. commercial system which is competitive with other systems in the world. I think it remains to be seen whether we can carry through this policy.**

The Administration's new policy, calls for no government competition with the private sector. However, it may take a while to get the government out of the business. Baldly put, it's awfully easy for the government organizations to spend money in developing systems — software, and so forth — that actually compete with the private sector. I know such practices have hurt the development of the remote sensing industry so far in this country but I hope that they will not continue to do so.

We now reach the question that we have already mentioned, the whole question of the policy that we have today — to encourage development of a U.S. commercial system which is competitive with other systems in the world. I think it remains to be seen whether we can carry through this policy. We've had an awfully difficult time since 1984, after the House Science, Space and Technology Committee generated the LANDSAT Commercialization Act and followed it through the House and the Senate, achieving a comfortable commercial arrangement for remote sensing. It really remains to be seen whether we can achieve it.

Next, I want to jump to some of the questions that have been raised with respect to Mediasat and its national security implications. The Mediasat concept would present the potential for the media to use data from a different vantage point, that of space. But, really, when you ask what difference does it make in how the government treats the media and how the media operates under First Amendment guarantees, we see that there's not a whole lot new with the Mediasat. It will make some of these concerns more pressing perhaps, but we have seen those kinds of concerns before between the national security forces and the media. Mediasat would probably compound some of the problems of management and national security and foreign policy, but OTA felt that that those problems were manageable.

NATIONAL SECURITY AND FOREIGN POLICY

o INFORMATION RE U.S. TROOP MOVEMENTS

o INFORMATION SENSITIVE TO OTHER GOVERNMENTS
-WOULD THESE COUNTRIES RETALIATE?

o INHIBIT RATIONAL CONSIDERATION OF CRISIS

o INADVERTANT INTELLIGENCE TO ADVERSARIES

o MEDIA MISINTERPRETATION OF DATA

Let's just run through the potential problems quickly. First their is the question of disseminating information regarding U.S. military operations that the U.S. might want to keep quiet. Such instances have certainly occurred before and in such cases the government must decide whether to issue prior restraint orders or allow the media to regulate itself in the overall national interest.

Of course, there's the question of revealing sensitive facts about an unfolding crisis, which might inhibit rational consideration of the crisis. If the media gets out in front before the heads of government are able to make decisions, that might force the governments into making snap decisions they would later regret. There's the point that Pierre Bescond mentioned of the media misinterpreting data so as to precipitate a crisis.

One important question that's rather interesting from a legal standpoint is the media revealing information considered sensitive by foreign governments. We have seen, particularly in recent years, the willingness of certain foreign governments to kidnap media people, to put them in jail, and so forth. The question I have is whether such practices might increase over time as a way of inhibiting media use of such data or even trying to get to the U.S. Government.

Finally, there is the important question of providing potentially valuable information to third parties in case of strife.

Now, the kinds of things that the U.S. government can do to regulate a Mediasat, such as reducing the allowable resolution limit, and we've just heard recently that that apparently is not a consideration today; forcing reductions in geographical coverage; censoring media images; and sometimes, in certain cases, such as the case of armed conflict, actually terminating the operations of Mediasat for a time.

I might say that if you look at these in detail and ask is it likely that the U.S. Government would pursue these for anything but a short-term arrangement, I believe you'd have to say that because of the existence of the foreign systems, it would be extremely difficult for the U. S. Government to pursue such restrictive policies on its own. There's just too much data out there and available from too many sources.

And, finally, let me make a few general points, some of which I have already made. The timing of a Mediasat is terribly important. It's not if these data will be used more effectively by the media but when, and whether or not we get a 5-meter sensor up now or a different system later on is really a timing issue.

o TIMING OF THE LAUNCH OF A MEDIASAT

o MEDIA WILL NEED PHOTOINTERPRETERS

o MEDIASAT WON'T EXIST INDEPENDENT OF OTHER MARKETS

o FLOOD OF DATA
-WHAT TO KEEP
-WHAT TO SAVE

o NEW TECHNOLOGIES ON THE HORIZON
-DOD LIGHTSAT PROGRAM
-NEW LAUNCHERS

o NEW SENSORS

One point that is terribly important is that the media will need photo interpreters to accurately understand what's going in a scene. If you look at a remote sensing image, except for a few cases, they're pretty hard to read. Those pictures we saw, the wonderful image of Washington, D.C., and New York City, they aren't so difficult because those of us who have lived in Washington or New York recognize them right away. But that image from the desert is another issue and really will need photo interpreters.

The next point, which I have already made many times today is that the media won't exist independent of other markets.

**One point that is terribly important is that the media will need photo interpreters to accurately understand what's going in a scene.**

Finally, I want to close on a technological question. One of the things we mustn't forget is that there are new technologies coming along on the horizon and there's some very interesting things going on in other areas. One is the DOD LIGHTSAT program, which we have heard both good and bad things about in the last few days. There may not be any particular item in the DOD LIGHTSAT program, per se, that would be appropriate for Mediasat, but bits and pieces of it, such as light weight satellite busses, should enable further development of technology which would be very useful for a Mediasat. For example, new launchers could radically reduce the cost to reach space.

Another point is the development of new kinds of sensors, such as radar. Both Canada and the European Space Agency are putting up radar satellites that will have rather low resolution but carry the advantage of seeing through cloud cover. Clouds cover over a considerable portion of the world, if you look at a data set that comes out on any given day, and a radar satellite would see through a good deal of that. I don't think we will see media use of that kind of data probably until the end of this century or the beginning of the next, however.

I think that summarizes pretty much what I had to say about the Mediasat. Thank you.

**MR. KOPPER**: Our final speaker of the afternoon will be Professor Bill Wirin of Colorado Springs.

**PROFESSOR WIRIN:** Maybe somewhat beside the point of my comments, but as long as Pierre and Gary have trotted out their commercial enterprises, I might as well say, as many professors, I also consult, and on one of the companies that I consult with, Space Commerce is prepared to provide, for those people that wish it, 5-meter resolution at a reasonable price and we're prepared to do it today. That's available from Soyuz Carta, a Soviet entity. So if you wish that, see me afterwards and we'll talk further.

But more to the point. The Secretary of Science for Canada made a most telling point about a year ago. He said that the United States, the USSR, and France know more about what's going on in Canada than the Canadians do. I would suggest to you that one of the tests of a recognized world state, if you will, is its own ability to sense not only itself but others, and as we have had presented here, remote sensing is going to proliferate.

Now, the extent to which a nation is able to acquire high resolution data, I suggest, will depend more about its internal processes and political desires than cost. I think cost will be a secondary factor when governments decide that they need information. But what we have been talking about today is more the commercial use of that information and I want to come at it from a slightly different perspective.

*PROFESSOR WILLIAM B. WIRIN was Command Competition Advocate for the U.S. Air Force Command at Peterson AFB, Colorado. His task was to eliminate unwarranted noncompetitive purchases; and to use the competitive pressures of the open marketplace to find the best technical solution, and to get the needed products and services at a fair and reasonable price. He earned a B.A. in political science from Occidental College, and his Juris Doctor from the University of Southern California School of Law. He was admitted to the Supreme Court of the United States; United States Court of Appeals; Supreme Court, State of California; and the Federal District Court for the Southern District of California. Professor Wirin is currently a Professor at Webster University.*

This morning we discussed the remote sensing principles, and I want to go back to Principle I because the key question, first of all, is news media use within the remote sensing principles. The key wording in that regard is, under Principle 1(A), which is a definition which says, "The term 'remote sensing' means the sensing of the earth's surface from space by using the use of properties of electromagnetic waves emitted, reflected, or refracted by the sensed objects for the purpose of improving natural resources, management, land use, and the protection of the environment."

I would suggest to you that a fair reading of that is that news media use is not within that specific definition. But I would go on to argue that it is a kindred use and, therefore, the rules which are laid down within the principles ought to be taken very seriously by those that are going to undertake Mediasat?

In that regard, then, what are the problems? And I guess the key question is, is there a crisis today? In my view, no. We have time to reflect upon the problems that I am going to discuss and come to some reasonable solutions. I do not believe that the media today has the money, has the market, or has the requirement to produce the kind of images that are going to be seriously threatening to nations and their governments.

I would also suggest that the kind of media use that we probably will see in the near term, as pointed out here already, is going to be, in a sense, after the fact. The news media will already be aware of the situation and then seek images either to corroborate or to disprove the assertions that are already made for a couple of reasons: One, there's just too much data out there for the news media to start sifting through film image after film image or data dump after data dump and come to any reasonable kinds of conclusion.

> **I do not believe that the media today has the money, has the market, or has the requirement to produce the kind of images that are going to be seriously threatening to nations and their governments.**

Secondly, the kinds of images or data that's available is difficult to interpret to the news viewer and, therefore, it will corroborate a story rather than be the story. In other words, if you have a picture of a shooting, that's a good story and it makes the story. But if all you have is some remote sensing that somebody died, that's going to need some interpretation. So it will follow after the story, if you will, or corroborate or, as I said, disprove.

Now, the question is, what are the risks involved? First of all, we have talked about no government interference. I do not believe that under the current policy, that the United States is likely to interfere with Gary and his friends, nor I do not believe that France is going to interfere with SPOT Image, with Pierre and his friends. But there's another side to government interference and that's one I want to zero in on.

Under the remote sensing principles, it says, over in Principle 14, and this is under the heading of "State Responsibility," while we are discussing here a First Amendment problem of freedom of the press, there's a new wrinkle to this or a different wrinkle which is overlooked by many of the people that have commented in this area, and that is that the United States has signed up to international responsibility for the activity of any U.S. operator of remote sensing information.

So if you will, there is a supervening problem in saying, does the First Amendment say this or say that. You'd have to read the First Amendment here in conjunction with the responsibilities which the United States has assumed under the Outer Space Treaty of 1967.

What are those responsibilities as they pertain to remote sensing under the principles?

It says, "States operating remote sensing satellites shall bear international responsibility for their activities and assure that such activities are conducted in accordance with the provisions of the treaty," meaning the Outer Space Treaty, "and the norms of international law irrespective of whether such activities are carried out by governmental or nongovernmental entities."

Well, what is the international law in the area? The international law in the area, I would suggest to you, stems from the United Nations Charter and has very specific provisions which says that no nation shall interfere with the internal policies, problems, or society of another nation.

Early on when these principles were being discussed there was a proposal put forth by the USSR and France to have two regimes: One that would apply to resolution images below and another regime that would apply to images which were above a certain resolution. The long and the short of that was if it was a 50-meter resolution, you could give it to anybody in the world, but if it really was revealing, then you had to get permission from that state before you could release it.

In that regard, I need to reflect back on the fourth principle where it says specifically that "these activities shall be conducted on the basis of respect for the principle of full and permanent sovereignty of all states."

Let us suppose that a Mediasat exists and that it's capable of 3-meter resolution and that there is an organization that would desire to do an exposé of the gulags in the Soviet Union, and that through means of satellite photography they have taken pictures of the various facilities and they are now going to run the story. I would suggest to you that the USSR might feel that that was somehow a direct violation of their sovereignty as guaranteed to them by the U.N. Charter.

Now, what is the problem for that corporation or that entity? I would suggest to you it may be one primarily based upon insurance, because if I was the insurance carrier, I would want some very specific kind of assurances from that Mediasat as to what kind of uses would be made of the information that is derived therefrom.

I should hasten to remind you that the USSR has an ASAT capability, and under international law they are privileged to shoot if you are committing an illegal act, and an interference with their internal affairs is an illegal act under the U.N. Charter.

Now, let us assume that that all occurs and you say, "But it wasn't illegal. I was acting in the best traditions of the free press and I was exposing to the world the violation of human rights." How are you going to sue somebody?

What I am saying to you is that while you are looking at these issues, you must be aware that those nations — today there is one principally that had the capability of stopping that satellite - may choose to do so if they feel that their internal prerogatives are being impinged upon, and that this whole discussion of Mediasat needs to recognize not only that aspect but the insurance aspects, because what if the newspaper misinterprets the data? What if there is, if you will, a defamatory, or a libelous assertion by the press based upon the information from the satellite? Presumably the satellite insurer could be libel along with the insurers of the newspapers and the print media.

**AUDIENCE**: So if a photographer has insurance on his photographic equipment that he goes down the street to take pictures of automobile accidents and they misinterpret a photograph, then the insurer of his camera equipment is libel?

**PROFESSOR WIRIN**: No, but the insurer of his conduct would be, and when you start talking about a space vehicle, there is not only insurance on the value of the vehicle but on what the vehicle does, on the conduct of the vehicle. I'm just suggesting there are some problems out there. I don't think they're insurmountable, but I would suggest that anyone who wishes to pursue this needs to do it carefully.

I believe that as far as the free press issue in the United States is concerned, that it's a fairly simple solution for the military. I think the military presently operates — one of the programs in Cheyenne Mountain is to alert military installations, and commanders, when, for instance, a photo reconnaissance satellite or an ELINT satellite is going overhead, so if they wish to roll a sensitive object indoors, they can do so. I would suggest that that is the practical solution here; that it is not the Mediasat which is the real danger, it is the espionage or the intelligence satellite and what will protect you from one will protect you from another, and as a practical political matter in the United States, that Mediasat will not be that much of a problem.

Thank you.

**MR. KOPPER**: I would like to ask both Gary and Pierre if they would comment very briefly on what limitations, if any, which they would like to discuss with us, has any government placed on either the taking of their pictures or the dissemination of the basic data or other information. Gary.

**MR. EDWARDS:** Well, I can answer that question very quickly. To date, we have experienced absolutely no interference from the United States Government in the operation of our system. You have to bear in mind it is, after all, a government-owned satellite, so one might anticipate that the government would feel some prerogative in that regard. But the fact of the matter is, we have had no interference from them.

We have received no indication, from the Secretary of Defense or from the Secretary of Commerce, that there is any inclination on their part to interfere in our operation of the satellite on a commercial basis. We have a statutory obligation to sell the data on a nondiscriminatory basis to all customers and to all potential customers. The only exception to that, by the way, is based on national security considerations determined by the Secretary of Defense. The Secretary has made no such determination in terms of any particular activity by EOSAT up to this point and we don't expect any such action in the foreseeable future.

**MR. KOPPER**: Thank you. Pierre, would you like to comment on that?

**MR. BESCOND**: The answer on our side is exactly the same. We have had no limitation at all.

I would like, though, to comment on the way we came to the 10 meters resolution. That was the subject of extensive talks with our government, including the Department of Defense. We conducted simulations and, as a result, it was proven that at 10 meters resolution, there would not be, at least from the French perspective, any national security concern, and I must say we're pretty proud to have led the way.

I very much enjoyed the recent declaration by President Reagan which disposed of the limit in this country, too, and I believe that the SPOT exposure of data has been probably one of the reasons why this policy has moved on in the States, probably the USSR as well, but for sure SPOT led the way.

The Soviets, after it was declared that they would do the same and expose the 5 meters data, have shown that they are not "open sky open access" and at least SPOT was the first to do that and was proven to be right now. I'm very glad the U.S. has taken the same route.

**MR. FAWKES**: Bruce, if I could clarify that.

**MR. KOPPER**: Yes, please.

**MR. FAWKES**: Speaking for the Department of Commerce, we have been sort of dealing with a phantom since theSecretary was given the licensing authority in 1984 for commercial remote sensing data supply. There has been a perception in the industry that a 10-meter resolution existed. There was nothing we could do to dispell that because normally national security reviews are conducted on a case-by-case basis as all you realize. The problem with having things done on a case-by-case basis is that doesn't give a whole lot of comfort to the private investment community.

So we sought, in the latest directive on national space policy, instead of the negative determination which is, "Well, come talk to us and we'll do it case by case," we sought a positive affirmation that there were no a priori limitations on commercial remote sensing operations. Now, that doesn't mean there are no limitations, it means that are no a priori limitations such as nothing under 10 meters will be allowed, nothing in these parts of the spectrum will be allowed, and the like.

So just by way of clarification and a positive statement, it should be noted there's only been one license application in the Department of Commerce and it was approved. So no one's ever been turned down, and we're encouraging people to come in. But we have been dealing with this phantom that there's this 10-meter resolution and no such thing has ever existed.

**MR. KOPPER**: Would you, when you are recognized, please stand and state your name.

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Colonel Jeffrey M. Graham.

**AUDIENCE**: Bill, I would just like to quibble with you a little bit on the question of national security and Mediasat as far as the United States is concerned. You are right, I think, as far as Cheyenne Mountain is concerned, that we can locate when a satellite is coming over and then hide something.

On the other hand, you can certainly envision a Honduran situation, a Panamanian situation, where we may just wish to move troops. You can't hide 40 C-141s on the runway at Pope Air Force Base or a bunch of C-5s which immediately will alert someone that a troop movement is coming up.

**PROFESSOR WIRIN**: Let me answer the quibble, if I may just quickly. I think that the media is the least of your worries if there are ten nations out there which have remote sensing capability. That's really my statement.

**MR. KOPPER**: Yes, sir.

**AUDIENCE**: Hi. I'm Wayne Dillingham for Gregg. As a follow-up to your last comment concerning the case-by-case determination and no a priori determination, have steps been taken to determine a definition for national security for this purpose in this context? I understand that's been a problem in several respects.

**MR. FAWKES**: Regulations were released last October that I think provide some more detail on the process, but the statute in the area defines that the Secretary of Commerce, in consultation with the Secretary of Defense, and Secretary of State, will make the determination, and the regulations have now been released on the license application process. So the Secretary of Commerce, when presented with a license application, will consult with DOD where national security or sensitivity are concerned.

**AUDIENCE:** So nothing has changed, then?

**MR. FAWKES**: Nothing has changed except to make a positive statement there are no a priori situations. And our perspective, as was noted earlier in these discussions, that the commercial and economic limitations on what the media might want to do are very probably more constraining than a national security sensitivity.

**AUDIENCE:** Thank you.

**MR. KOPPER:** Mr. Byerly.

**AUDIENCE**: Rad Byerly. I would like to take off on a point Bill just made but refer back to Ray's slide on national security implications in which he quite correctly pointed out the things listed there are not new concerns. Bill points out ten nations, but at least one nation that has reconnaissance capabilities probably greater than the media will ever have. So they have all this information about the C-141s. Presumably they systematically use that information against us whenever they want to.

What's the big deal? What's the new problem that we're worrying about here that's different? Who are we trying to keep ignorant other than the American citizens? That's really my question for anyone, if anyone.

**AUDIENCE:** I think Bill makes a good point, but I think the other side of it is that there is an agreement, if you will, an unstated agreement by the major powers that whatever information they have, they may communicate with one another, they may do nothing. You have almost a sense of responsibility between major powers.

Now, the question — if it's just released by the press, if the United States wishes to take an action somewhere in the world, then the United States is forestalled from taking that action even though another major power may not object.

**MR. KOPPER**: Yes, Bill.

**PROFESSOR WIRIN:** Jeff's comment is well taken, and I think the real point is the foreign policy arena. In other words, it's going to take, if you will, developed nations launch these kinds of systems. If the adverse information is released, that foreign nation's nose may get badly bent out of joint, and that's where I think the political problems come in and that's a foreseeable problem.

**AUDIENCE**: May I?

**MR. KOPPER:** Yes, Mr. Cooper

**AUDIENCE**: I'm Monty Cooper. I was just curious. I see a foreseeable problem that you didn't mention. I was curious. Suppose you have a Granada situation where the U. S. Government has kept photographers out of the military zone and then you sent across the Mediasat and it shows what the government regards as sensitive information, and they go to a U.S. district judge to get an injunction on this information and the press releases it, say the UPI or AP goes ahead with it. In that case you don't have a reporter for whom you can show violation or a cause of action against. Who does get sued? You don't have any contempt of court on an individual person.

**AUDIENCE**: You get away.

**MR. KOPPER**: Yes, Mr. Marks.

**AUDIENCE:** Yes, my name is Bob Marks. I'm an attorney in Denver and had the pleasure of serving on one of these panels last year. I wanted to take off from Bill's point, if I might, bringing us for a moment back to the civilian side of these issues or commercial side.

It occurs to me that, in your example citing sensing of the Soviet Union, you're dealing with a country that obviously has the military ability to stop a satellite.

**PROFESSOR WIRIN:** Right.

**AUDIENCE:** We, in turn, presumably could send the armed armada to protect the satellite on high seas, as we have often done. So you have kind of a neutralizing potential.

But if you are a Third World nation that doesn't have ASAT capability and that nation believes that what you are doing may upset its internal affairs, presumably hire Washington counsel to go to the Federal District Court in Washington and get an injunction not only against dissemination of the data but perhaps asking that the switch be thrown and the satellite turned off.

At that point I suppose the people who are funding the satellite project might turn to the insurance company and say, "Guess what, we just lost our satellite. Now we'd like to recover the insurance money." You can posit these things on and on.

The other approach would be that whoever says that they're being harmed, in view of the fact they might not have equitable relief available, might decide to sue for damages, and I suppose if what you are revealing is a coup or potential coup or a change of government, you may have issues then of just who can bring this lawsuit for damages like a derivative doctrine in a stockholder action.

In any event, that seems to me to be the kind of scenario that would be more appropriate for the commercial consideration; whereas, the military example that you gave sort of resolves itself on known principles of international law.

If you or anybody else wants to comment on that, I'd appreciate it.

**PROFESSOR WIRIN:** Let Neil comment.

**AUDIENCE:** Let me get out my second question and then I'll sit down. A lot of what I have heard discussed so far is focused on the question of higher resolution, higher and higher resolution leading to issues. I suppose as you get higher resolution you arguably develop a more intrusive kind of remote sensing, and at least in our own domestic legal system we have some ways of dealing with that.

What I haven't really heard identified yet in the spirit of your comment that maybe we have some issues yet to come that we have time to reflect.

I'd also like to throw out for consideration what happens when the remote sensing is not passive but active. Somebody mentioned that we may apply radar and may be able to penetrate cloud cover. In fact, radar is an electromagnetic form of energy which indeed penetrates and intrudes, and one may very well be able to make a good case that to the extent remote sensing becomes an actively intrusive sort of activity, there may be some legal avenues for relief that wouldn't be available where passive sensing is occurring. I throw those out. You're free to comment.

**MR. KOPPER:** Would some of the panel like to comment on the question? I understand that we have in the audience a Mr. Neil Hosenball.

**MR. HOSENBALL:** I just wanted to make a short comment, point out something that Ray quickly said and it shouldn't have been passed over.

I guess I have been attending Mediasat conferences for about two or three years now, and it seems to be a fun thing for the media because it's a First Amendment issue. I'm not sure that the media have really looked at the balance of their own interests, both financial and from a news reporting point of view, and from their ability to give worldwide coverage to the United States and to the world.

I only point out that they certainly aren't going to use a Mediasat in the United States. Helicopters, and TV vans, they will be there before any satellite ever gets there.

And so where are they going to use it? They're going to use it in places where you can't — that are closed or largely closed to reporters, such as the Soviet Union and eastern block countries—

**AUDIENCE:** —or Afghanistan.

**MR. HOSENBALL:** —or they're going to use it in developing nations where it may be very difficult to find a helicopter or to get into an area.

What does that mean? It means basically that, again, the Third World is going to look at the United States as being the owner of all the international news.

Now, the journalists are in enough trouble in the Third World. The U.S. has pulled out of UNESCO primarily because of resolutions that affected the press. The requirement for press cards restrictions about getting into a country, moving around a country the U.S. left UNESCO for those reasons.

I think the media have to really balance the issues—balance what they're getting against what they may lose. Whether this is anything more than a fun exercise. It is an easy thing to say First Amendment, national security, here's Uncle Sam again, won't let us do something that we want to do. I'm not really sure how serious they are.

**MR. KOPPER:** More questions? In the back there, sir.

**AUDIENCE:** What is being done to to provide technical protection for the downlinks on each of your spacecraft?

And am I correct that these are not noncrypted. It's really a two-part question. These are noncrypted downlinks which means they're available to anybody who is moderately technically sophisticated to listen in, and we would consider consortium of press people moderately sophisticated.

So if, for example, the national government said to EOSAT or to SPOT Image, "You must not distribute pictures of this particular area," in fact, if the downlinks are noncrypted, the media could be listening in and your control measures are a leaky sieve.

Now, there's another part to this dilemma and it bears on the Communications Act of '34. If in fact your downlinks are noncrypted, that means under the Communications Act of '34 that anybody can access those and use them for noncommercial use. For example, Greenpeace might want to use your images for noncommercial purposes to show shooting seals on a polar cap.

Have you taken this into consideration and what is your response?

**MR. KOPPER**: Pierre, would you like to answer that one?

**MR. BESCOND**: Yes. The answer to your question is the data are not crypted, that's true. We are considering for later purposes whether we should encrypt, not just for commercial purposes, but because of overlapping between some stations for example.

The effort to get our data and do something with our data if you were pirating the data is not moderate, it's a very big one. The price of a station to receive this data is estimated to be between 10 and $50 million. When you have a station it is not enough, you have to have ancillary data, you have to have the variables from the satellites. Admitted, that this is not very complicated, but, again, it requires a sophisticated installation. And you have to have the message of programmation of the satellite. So it does require a big deal of intelligence, and I would say even espionage before you can do that and it's much cheaper to just buy the data.

**MR. KOPPER:** Gary, would you like to comment?

**MR. EDWARDS:** Yes. A couple of points. To answer the first question directly, in London last September I announced that LANDSAT 6 would contain equipment to encrypt the downlink of the data. Since then the budget ax has intervened, and while we are still entertaining that notion, it's not clear at this point whether or not the data will be encrypted.

I think Pierre's point is well taken that, first of all, the only time that these spacecraft are actively downlinking data is when they are within the acquisition radius of one of the ground stations which is capturing the data. So now certainly the acquisition radii of all of the ground stations worldwide do cover a large portion of the land mass in the world. But, first of all, you have to be within the acquisition radius or you won't receive anything; the spacecraft won't be switched on.

Another point, I believe it is Section 605 of the Communications Act that talks about the interception of radio communications, and that is not dependent upon the data being encrypted. It talks about unauthorized interception and disclosure, or use, as I recall. Certainly if you are in the United States, that's going to be of help. It has not, by the way, been a substantial problem. We have heard of a couple of occasions where we think people may have pirated our data, but to date it has not been a big problem.

**MR. KOPPER**: Dr. McGlick in the back row.

**AUDIENCE**: I want to make an obvious comment because I haven't heard it yet. The Mediasat issue of governmental interference with the freedom of the press, and so forth, is not a new issue, and I frequently read, when people are congratulating themselves in the press, that we withheld a story of such and such a nature for two days until the government was willing for us to release it. I think that this interplay between the media and the government will continue indefinitely and there will always be an uneasy tension between the two, and that whether the Mediasat exists or not, that problem has been, and will be a problem that we will have to live with.

But I want to ask one question of Gary and Pierre. I think Pierre said we don't need anything better than 10 meters. I think Gary said we need something considerably better. Now, did I misunderstand, or is there a difference of views?

**MR. EDWARDS**: I don't think you misunderstood. We have spent a good deal of time and effort in evaluating where we want to go from here. How do we get from here to there? Right now as the legislation enacted in 1984 acknowledged overtly, the land remote sensing market is not large enough currently to support fully commercial private operations. Our job, therefore, is to expand that market, and in the process of doing that, we are looking at where this industry is going, what uses are likely to be made of this data, what uses could be made of it that are not currently being made of it, and for what reason. We have spent a good deal of effort in the last couple of years surveying the market and we have done specifically market surveys with respect to user interest in 5-meter frequent coverage. The results of our survey indicate that not only in the media but in numerous other industries and areas also, there is a high degree of interest and demand for this type of data.

Now, it is not inexpensive. But what we are talking about is putting this instrument, if possible, on LANDSAT 6 so that we would be talking about is the incremental cost of the sensor itself and a little bit of cost to accommodate its integration into the spacecraft and perhaps some ground processing equipment as well. We think that it may well be economically feasible in the LANDSAT 6 time frame, at least on an experimental basis, but that depends on a lot of things, including the outcome of our discussions with various potential purchasers for it. We certainly will not do it unless it looks like it is economically feasible.

**MR. KOPPER**: Pierre, would you like to comment on that question?

**MR. BESCOND**: Yes, Gary has said it, really, but what we found ourselves was that the market at 5 meters was not significant enough for us to spend a big deal of money to go to 5 meters resolution, and from the experience that we have had with the media for now nearly two years of trying to sell them data, I can tell you they don't spend much, they're not a big account.

**MR. FAWKES**: A quick point of clarification if I could.

You know, it's fun to consider — perhaps it's fun for lawyers to think about the excitement and the fees of rushing down to the courthouse to get that injunction, but in point of fact, before a commercial remote sensing operator is licensed in the United States, some fairly serious consideration will have been given to the potential uses of the technology sweep that's being proposed.

Our military friends and intelligence friends have been playing every game imaginable with this kind of data for 30 years now.

The media capability from a technical standpoint will always be less than the military capability.

My military friends are very careful people. I'm sure they will run lots of scenarios on the potential uses of the technology before the thing is licensed.

So I have a little bit of difficulty in my own mind constructing situations where suddenly you are going to have the government intervening to try to shut something down that's already been licensed to operate because very serious consideration would have been given in advance to all the potential uses of that satellite.

**PROFESSOR WIRIN:** I just wanted to add that in the interest of competition, we are prepared to test-market that concept.

**MR. KOPPER**: It is 4 o'clock and we did promise that we would stop at 4. If anybody has any other questions, I'm sure that individual members of the panel will be happy to have you come up and ask them here.

I'd like to thank each member of the panel for being with us and to Mr. Fawkes for coming all this way for this short time.

Thank you very much, and we are adjourned.

# SPACE & AVIATION EDUCATION FORUM

# UTILIZING SPACE FOR QUALITY EDUCATION

*Moderator:*
**Dr. Victoria Duca,** Director of Special Projects, U.S. Space Foundation

*Speaker:*
**Beryl Dorsett,** Assistant Secretary - Elementary and Secondary Education, U.S. Department of Education

**DR. DUCA:** Good morning, and welcome to the Space and Aviation Education Forum. I am Victoria Duca, Director of Special Projects for the Foundation.

I would like to introduce Beryl Dorsett, who is the Assistant Secretary of Elementary and Secondary Education for the United States Department of Education.

**MS. DORSETT:** Thank you very much, and good morning, ladies and gentlemen.

I'm really delighted to be here in Colorado Springs, and as it is my first opportunity, I'm most excited about this Symposium. I must say I've never seen a greater gathering of people who are more friendly and courteous than this group of people, so you really need to be commended.

In education, we are experiencing a crisis in math and science.

We hear a lot these days about how we are in the midst of the information revolution. Advanced computers and electronics that make possible rapid processing of information are transforming our economy from one based on manufacturing to one based on services. By the turn of the century, only twelve years away, an estimated seven of ten jobs will be related to the new technologies. And the United States, many say, because of its traditional leadership, is in a good position to reap the benefits.

> **We look at our country's lagging performance in science and math education, and worry that the information revolution may be a threat rather than an opportunity.**

But many of us in education — and some in business — aren't quite so optimistic. We look at our country's lagging performance in science and math education, and worry that the information revolution may be a threat rather than an opportunity. We may be unable to keep up with the scientific advances of a rapidly changing world. How sad it would be if we failed to capitalize on this technological revolution with the same success we have met other economic challenges. It's not only a challenge of preserving our economic pre-eminence, but of new, exciting careers and better lives for those with the right

*BERYL DORSETT is the U.S. Education Department's Assistant Secretary for Elementary and Secondary Education. Dorsett was nominated to the post by President Reagan on February 25, 1987. Before joining the Department, Dorsett was Assistant Principal of Roland N. Patterson Community Elementary School, Bronx, New York. She was the Acting Principal of Community Elementary School 73, Bronx, New York, from August 1986 to January 1987, and coordinator of social studies, New York City Public School System, District One, from September 1985 to August 1986. From August 1984 to August 1985, she was on sabbatical leave conducting educational studies in Africa. Dorsett was an assistant to the principal of Jordan L. Mott Community Junior High School, Bronx, New York, from 1983 to 1984. She served as director of the Chapter 1 Programs (formerly Title I Programs, Elementary and Secondary Education Act), Bronx, New York (1979 to 1983) and assistant director, Title I Programs, Bronx, New York (1978 to 1979). Dorsett received a B.B.A. degree from Baruch City College of New York in 1964. She also studied at City College of the University of New York, Rider College (Trenton, New Jersey) and Hofstra University (Hempstead, New York). The Honorable Beryl Dorsett, a Charter Member and Past President of The Williamsburg Club, Bronx, New York, has served her community with distinction and is the recipient of the Sojourner Truth Award.*

training. Math, science and technology can be for everyone. They're fascinating, and as you know, the study of science teaches students how to think critically and solve problems.

But international test comparisons present a bleak picture of our education performance. Recently, the National Science Foundation released a science achievement survey that stated United States fifth-graders ranked 8th of 18 countries, and our ninth-graders ranked 15th of 17. Advanced placement high school chemistry students were 11th of 13 countries, and similar physics students came in 9th of 13. Great Britain, Finland, Hungary, Japan, Korea, the Philippines, and Poland were among the countries included in the report.

In mathematics the story, unfortunately, is similar. Our eighth-graders fall way below students in other countries in solving problems that require analysis rather than just memorization. And the average Japanese 12th-grade math student does better than 95 percent of comparable U.S. 12th-graders.

Much of this was reported in the **Nation at Risk** report. A follow-up version will be coming out from the Department of Education on April 26th, but we must never forget its powerful warning against the "rising tide of mediocrity." "If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today," the report stated, "we might well have viewed it as an act of war." Indeed it added, "We are raising a new generation of Americans that is scientifically and technologically illiterate."

The International Association for the Evaluation of Educational Achievement has stated the way science is taught in this country has to be re-examined. A weak curriculum; shortened instructional time; irrelevant and little homework; unqualified and bored teachers; with minimal course requirements, not only are giving us poor results, they're also turning off many of our students to science and mathematics. Far fewer advanced students are going into related fields; 2,918 students earned Ph.D.s in chemistry and physics in 1986, compared to 3,605 in 1970. In mathematics, the number was down from 1,236 in 1970 to only 742 in 1986. Ph.D.s in engineering dropped from 3,681 in 1970 to 3,400 in 1986.

**"If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today... we might well have viewed it as an act of war."**

Those figures are shocking.

Compounding the problem, as noted by NSF Director, Erich Bloch, is that the college-age population peaked in 1983 and is expected to decline for several decades. To maintain our current level of scientists and engineers, we will have to attract a higher proportion of our students into these fields, as Japan and other competitors are doing with their students. So far this decline — in the face of growing demand — has been somewhat mitigated by foreign students, who earn about one-half of the engineering doctorates and one-quarter of the 15,000 total science doctorates given in the United States each year.

These trends make it all the more important that we attract more minority students and women into science and mathematics, especially when by 1995 the Black and Hispanic people are expected to make up as much as 40 percent of the country's college-age population.

How do we go about expanding the pool of our potential scientists and technologists? Most important — we have to begin at the early childhood level. In order to minimize their resistance, math and science must be made exciting and interesting, and taught by creative teachers who know their subject. The Johns Hopkins Center for Research on Elementary and Middle Schools, in a project funded by the United States Department of Education, found that a majority of girls, minorities and the disadvantaged are lost to these subjects by the time they leave elementary school.

Some recent studies have shown that, fortunately, the situation is beginning to change, especially for females, as each year more and more of them are becoming interested in these important subjects. But generally, the small numbers of all these groups in math and science, both in high school and college, can be traced right back to that elementary school.

So the first thing we have to do is change our approach toward the youngest children. The worst thing is to stigmatize the youngster because he or she doesn't fit the image of a science student. Each and every child must be treated as an individual. Each and every child must be held to high standards and encouraged by high expectations. We often don't know young children's potentials, and mathematical ability can develop at different ages.

**Some recent studies have shown that, fortunately, the situation is beginning to change, especially for females, as each year more and more of them are becoming interested in these important subjects.**

Therefore, all children should be exposed to the study of mathematical concepts rather than be limited to the study of computation. Challenging curricula and good teaching help to develop positive attitudes, confidence, and interest in the subjects. Some students need more attention and encouragement, but starting from a disadvantaged background shouldn't relegate them to a "slow" or remedial track, which helps to guarantee a permanent underclass in this great country. These students need the very best teachers.

The second thing you have to do is improve teaching of mathematics and science at all grade levels. "Seen only as a laundry list of theorems in a workbook, science can be a bore," Secretary Bennett wrote in his report on elementary education, **First Lessons.** "But as a hands-on adventure, guided by a knowledgeable teacher, it can sweep children up in the excitement of discovery."

What can be more exhilarating than the work that some of you here today do? Exploring the heavens, searching for life beyond earth, sending men to other worlds, deciphering the nature of the universe. The subject is clearly a winner. We need only to introduce this beautiful, interesting and exciting subject, science, in the right way and students will never want to leave it. And it's not just beautiful, it's crucial to our country's future.

As you know, we have a reform movement in science education. Its aim is to make science learning less passive and abstract, to make it a hands-on experience. We are moving away from the excessive emphasis on theory and memorization, instead tying students more to real-life experience. In addition to science exploration, areas like medicine, energy, genetics, superconductivity and the President's Strategic Defense Initiative offer great potential for making science vivid and important to students. One mark of a good teacher is to make the basic principles understood by his students.

**We need only to introduce this beautiful, interesting and exciting subject, science, in the right way and students will never want to leave it. And it's not just beautiful, it's crucial to our country's future.**

It can be done, yes, it can be done, and it has been done. At schools like Manchester Gate Elementary School in Fresno, California, and the Baltimore Polytechnic High School, which is a math/ science magnet school in Maryland. At the Manhattan High School in Kansas, whose unified science program includes a mix of students at all levels, and at many others, like the Rex Putnam High School in Milwaukee, Oregon; elementary schools in the Washington School District of Phoenix, Arizona; the renowned Bronx High School of Science in New York City, and the Gateway and Hinkley High Schools right here in Parker, Colorado.

There's a new film out about a very brilliant math teacher. His name is Jamie Escalante, at Garfield High School in east Los Angeles. The students are almost totally Mexican-American and many are disadvantaged. In 1979, five of his students took the advanced placement test in calculus, and by 1986, 85 were taking it. Good news: 30 of his students got a perfect 5, and all the rest received scores of 4 or 3. He has conveyed the excitement of mathematics to many students who elsewhere would never have had the opportunity to learn how good they are in mathematics and how much they enjoy it. Think of the waste in lost personal satisfaction — for students and parents — and in lost careers. And think of the difference Jamie Escalante is making in the lives of his students. That's the human drama that lies at the heart of the issues we're discussing today.

And the way it's done, as in all education, is with the old rules — high standards and expectations, lots of homework, rich curriculum and good teaching. We have a duty to provide well-qualified teachers and I'm sure in each state you have found your own Jamie Escalantes. But according to the National Science Foundation, about 30 percent of all high school science and mathematics teachers are unqualified. Can you imagine this happening in Japan? Only about one in three elementary school teachers has taken a college chemistry course, and one in five a physics course. But I applaud the states that are now requiring teachers to major in subject areas other than mere education.

**Public high schools' graduation requirements in math and science are about one-third less than those recommended by the *Nation At Risk* report, and I ask you this question: When will every state implement the recommendations of the *Nation At Risk* report?**

The third thing we have to do is to devote more instructional time to science and mathematics. Science, especially, is taught less than any other subject in elementary school, often because the teacher is not qualified or is simply not interested. And even worse, about 30 percent of our high schools offer no physics courses, about 18 percent no chemistry courses, and 8 percent none in biology. In addition to closing this gap, high schools should have science remedial courses like they have in reading and mathematics. Public high schools' graduation requirements in math and science are about one-third less than those recommended by the **Nation At Risk** report, and I ask you this question: When will every state implement the recommendations of the **Nation At Risk** report?

Much of what I've said is pretty depressing. Although I've painted a rather stark picture, I take hope from the reforms that are underway and from the many marvelous persons, and organizations like yourselves at this Symposium, striving to make things better: Like the United States Space Foundation and Dr. June Scobee's Challenger Center for Space Science Education.

But first, let me turn to the role of the United States Department of Education and its Office of Elementary and Secondary Education, which I head back in Washington, D.C. Our main role in this area is to give support to improvement efforts by those with the direct responsibility, the state and local education agencies. We do this through Title II, the Education for Economic Security Act, passed in 1985. Recognizing the magnitude of the problem, Congress authorized assistance to improve teaching in mathematics, science, computers and foreign languages, and to widen access to these fields for all students, especially the historically under-represented minorities and females.

This is the only federal program that authorizes funds to the states both at the elementary and secondary levels, and the higher education level. In this fiscal year we are expending $72.5 million. In '88-'89 it will be $109 million.

The program's main emphasis has been on teacher skills, instructional materials and equipment, and improving the access of females and minorities. Many of these services have been provided by universities, as well as businesses, museums and other community organizations working through partnerships with education institutions.

States have begun to compile a list of outstanding programs, which they're distributing as widely as possible. Business partnerships with schools also are extremely important.

**National leaders in science and industry are attending this symposium. We need your help. We need you to help us keep the pressure on at the local level for improvement in mathematics and science education.**

One example is in Massachusetts, where Digital Equipment Corporation is working with public schools to train females and minorities in the new technologies, with the emphasis on the early grades. Funding to launch the program came from the department's National Diffusion Network. We're quite high on this partnership because it reaches so many; it has received the White House Award for Superior Private Initiatives, and could be a model for other states.

National leaders in science and industry are attending this symposium. We need your help. We need you to help us keep the pressure on at the local level for improvement in mathematics and science education. And I thank those of you who are involved in education, and encourage more of you to join in partnerships with our schools. You can give teachers access to the cutting edge in science and technology; they need this access to do better. One example is the United States Space Foundation's work with the Pikes Peak area school districts to develop curricula that bring space science into a number of disciplines. The Foundation is doing much else, and I strongly commend it for its leadership in this area, including its television public service announcements featuring our four living Presidents that I saw last night.

**One example is the United States Space Foundation's work with the Pikes Peak area school districts to develop curricula that bring space science into a number of disciplines.**

Business already spends huge amounts on education — can you imagine over $100 billion, according to estimates — which compares with the $160 to $180 billion already spent on public education. The programs it has developed hold great promise for the public schools: Use of high-powered visuals, satellite technology and interactive video, for example. They were developed to facilitate retraining of workers, but they can be adapted for children too. Business' approach to education also features tools stressed by Secretary Bennett: Focus on outcomes; cost effectiveness; use of technology in the classroom and accountability. Our future economic standing is at stake. Business and academia need to get much more involved.

But, as I said, it's as much a human problem as an economic one. It involves the future lives of millions of our children: Not only the fulfilling careers and the joy of learning fascinating subjects, but the flowering of their minds. "Probably the single greatest contribution which early education in science can make to a people is the development of a belief based on evidence that they can, to some extent, influence the direction and quality of their destiny." Those words of a scholar in the field, which we take for granted in our lives, bring out of the crisis of math and science education in its widest dimension.

**Our future economic standing is at stake. Business and academia need to get much more involved.**

Well, let's get on with the task. We must get on with the task. In closing, I would like to note a number of those things that I have seen work effectively as I travel across this country:

Regular science curricula at all grade levels, accompanied by standardized testing every two or three years, as is done for reading and mathematics.

Training of teachers, especially at the elementary level, to be qualified in science instruction.

Business sponsorship of small science laboratories in schools; you would be surprised how many schools in this nation don't even have a valid science program.

Scientists conducting projects and demonstrations at schools. Students love it and they're simply turned on.

Adoption of school plans to improve teaching of science.

**By the year 2000, we should have the next generation fully prepared for the scientific challenges of the 21st Century.**

And I regret to say but I must say that there should be at least one teacher in every single school in America who's qualified at a level that permits the teacher to train other teachers.

But I will end with this challenge: By the year 2000, we should have the next generation fully prepared for the scientific challenges of the 21st Century.

We'll do our part in the United States Department of Education, so continue to help us. I know it can be done.

Thank you very much, very much.

**DR. DUCA:** Do we have any questions from the audience?

**KATHRYN MARTIN:** Yes, Ms. Dorsett, you indirectly said it and referred to it, but there's quite a bit of racism in the classroom.

**MS. DORSETT:** Quite a bit of what?

**KATHRYN MARTIN:** Racism in the classroom by the teachers themselves. The Asian student and the White student are more likely to be directed into the science and math programs, while the Black, Hispanic and American Indian students are less likely.

How do we change it from the classroom level?

**MS. DORSETT:** You know, I don't want you to put me on the carpet. Actually, I think the parents must play a greater role. You know, the answer really is the parents. The Asian parents are behind their kids all the time.

The only way we can improve our system is for every parent to get out there and demand that their kids receive the better education. There is no other way.

**CANDY WESTFALL:** Are there any programs in place to help do that? You read articles in the paper about a principal who was picketed because he wanted to fail students in high school because they could not read. And, you know, he was kind of burned at the stake because he was going to damage these kids' feelings for the rest of their lives because they were being failed.

**MS. DORSETT:** That again comes to parent education. You know, I don't see the sense of moving a child on if a child cannot read. What good is a certificate? It is worthless if children cannot express themselves and be effective.

All this begins, however, in the elementary schools.

You know, back in New York City, I was a principal before coming to the Department of Education. There are 622 elementary schools in New York City and they're ranked by reading performances. I was so fortunate to get a school that ranked 618, fourth from the bottom, and I want to tell you that it was a disgrace. Maybe one day I will write about that school. I should say, how kids ran the school while the principals sat back; while kids walked in garbage up to their ankles; while teachers threw the kids out into the hallway and locked their doors; while kids played around in the hallways; and the drugs were pervasive everywhere in the neighborhood, and kids picked up the crack and brought it to me. And yet, when I took one crack vial and placed it into a cellophane bag and placed it on the bulletin board for teachers to see so they can tell what this crack is all about, a teacher reported me as having crack in the school.

**The only way we can improve our system is for every parent to get out there and demand that their kids receive the better education. There is no other way.**

So I know how difficult it is. I must tell you that I saved the lives of those 950 Black and Hispanic kids by turning around that school, but I had the parents on my side.

I met with those Spanish parents every single morning, every single noon and evening, and told them that this school ranks 618, and if this is the way they want their kids to be in life... and they worked with me and together we did it, so it can be done.

But it's a total effort and it cannot be done by administration alone. It is true that you do need effective leadership, and I didn't know how effective I was, but I know that it was either their survival or mine.

**FAWN VRAZO:** Your opinion, please, of Joe Clark, New York.

**MS. DORSETT:** I think that if leadership comes from a point of love and understanding and a respect for those children, that they'll understand and grasp the need of being educated.

I think he had to do what he had to do, but I'm hoping that it will not continue, you know, for years to come.

I think the worst students are now out of that school and I don't see why the children, with the parents' help, cannot produce the kind of student that they would like in this society.

Any other questions?

**DAN DONOHUE:** I read recently, I think it was in the Chicago School District, that they voted for funding of 160,000 hand-held calculators to help in math. Would you comment on it?

**MS. DORSETT:** You know, I went into a grocery store the other day to buy some groceries in Washington, D.C., and a cashier tried to plug in the figures and the machine wasn't working, and guess what happened? You guess? He could not add up the items that I was purchasing.

You know calculators play a major role in technology, but math computation skills must be learned first, and if they're replaced, if these things ever go down, believe me, I don't know what's going to happen to America.

That's all I have to say about that.

Yes?

**PAT JAMES:** There's a lot of attention being put on elementary school aged kids, first, second and third and what not, and it seems to me, if the statistics I read about how many kids are held from going from one grade to another, that we're concentrating so much on the younger kids and pushing the curricula down, that they burn out because they don't have time to be kids. And then when you see them in college, they don't perform because they didn't learn how to crack a book in high school.

**The one thing you see in other parts of the world, in nearly all parts of the world, they look at education as serious business. It is a part of their national policy.**

So while I commend the effort to reform, it seems like one of the segments we're missing out on is the high school aged students and we're focusing the attention on the young kids and burning them out, and actually sort of self-perpetuating the problem.

**MS. DORSETT:** See, I can't agree with burning kids out. You can never burn them out, no. I don't believe that. I think that kids need to be inundated, with academics. I think the real problem is that we don't have the quality teachers that we should have in this system.

Teachers really don't know how to teach. They really don't. They need a lot of help, and unless we can find ways to make education much more interesting to children, when they first come to school, they want to come to school. They can't wait to get into the school building. It's what happens to the second and third and fourth graders, what happens to them? You know what happens to those kids? They're turned off by these boring teachers.

If teachers really loved and were really interested in those children — and many of them are — you can do wonders with the mind, because it has nothing to do with economics, with race, nothing at all.

A teacher can make the difference and teachers have made the difference.

**DR. BOYD BALDAUF:** I would just like to say in answer to that, I have traveled around the world, as I'm sure you have, but specifically looking at education through Phi Delta Kappa, and the one thing you see in other parts of the world, in nearly all parts of the world, they look at education as serious business. It is a part of their national policy.

I spent about 44 years in the Air Force too, so I have been with that for awhile.

I have seen, as I put together education, aerospace-ed workshops, and give teachers new tools to work with, spend about 17 or 18 years in teacher ed, teachers need to be told that teaching is a performing art. It is. The citizens in America wanted football, they wanted athletics, first. My little daughter teaches fourth grade down here at Wright, she wanted to help a youngster with some extra work. The mother demanded that she not work with him after school because he had to get out and play football, you know.

**MS. DORSETT:** I met with a group of Koreans recently back at the office. I was commending them for the jobs that they've done with their students. I said, "Well, who teaches your kids back in Korea?" They said, "All Koreans." And I said, "Well, how is it that your kids are doing so well?" They said, "Education is next to Godliness," and I think we really could transfer that into our American system. We would make a great difference. This is a great country. We have more than any great country, and I don't see why we aren't producing the kind of minds that we should be producing. I know the problems, I've been in those schools, and the money does not make any difference, not at all.

**KATHRYN MARTIN:** As an education reporter, I get a lot of material at the office and I take a lot of education conferences, and you hear that our students can't read, can't do math computation, they don't know anything about science, they have no idea, sometimes, where the next door neighbor's state is, much less where Thailand and Vietnam are.

The teacher pay is low; it's getting lower. There's parent apathy, there's the problem with drugs, and the problems seem to go on and on and on, so where do you begin to solve the problems so that everything is fixed, or, at least, getting to be fixed? That's an easy question.

**MS. DORSETT:** You know, teaching should really be a calling to the profession. It should be like a ministry. You should not teach for the money alone.

"Education is next to Godliness," and I think we really could transfer that into our American system. We would make a great difference.

I worked as the principal in a school where I was paid a teacher's salary. My sister principals received more money than I did, and I didn't say, because I received teacher's salary, that I was not going to do the job. I was committed and dedicated to doing something for those children because I knew those same kids would be mugging me, in another couple of years.

But see, when I left the school to come here to the Department of Education, we all cried together. We had one big crying fit in that school, because they realized that I really cared for them, so it's not money at all. I think that it's a real commitment, and it's your commitment.

I look at the non-public schools across the country. They're doing some great things with the children, and they have 60 and 70 kids in a classroom.

I also feel — and this is not policy, per se — but if parents had to pay something for their child's education, that would make the difference, even if it's just five or ten dollars a month. To pay something would make them much more interested and aware of their need to support that school endeavor and school programs.

**TONI C. BROWN:** I have to talk with this gentleman from the services, I'm a second-grade teacher. I'm a former high school English teacher, but right now I have been teaching in second grade, and I think we have answered several different times, the difficulty is in the elementary school and not pushing more material down, but with the teachers.

My kids can hardly wait to get in the door in the morning and they start pestering me about things, but they know — they almost want to get rid of me, because when I go to a conference they say, "What are you going to bring us back?"

When I went to Los Angeles for the National Congress on Aviation and Space Education two weeks ago, I had three maps up on the wall, because we did an air lift and they had to figure out where I was going — second-graders. They know I'm down here in Colorado Springs, but the map is up on the wall again and they're figuring out where I'm going.

But when I come back from Los Angeles, I brought back seashells and we looked at seashells and talked about the seashore, but — we're doing money with second-graders right now, and they had to sell seashells to — I mean, we had to say seashells, that part of the language; but then part of their math activity with money was to take the seashells that came from Los Angeles and sell them to each other, and they had to figure out what the prices were.

And we do science things all the time.

What happens if you push all of that down — I'm a Young Astronauts chapter leader, and the kids in my class can hardly wait to do something every day with their planes, and I don't know what's going to happen to the third-grade teacher next year, because those kids are not going to let that third-grade teacher not do something.

If we start and we push those ideas — and my kids can calculate the mileage, they can calculate wind direction; I'm a pilot, so we do headings and wind things — they can calculate that.

Wednesday night with Young Astronauts, chapters kindergarten through ninth grade, the kindergartners can calculate the wind's direction, so it's not too hard for them.

But it's, as several people have mentioned, it's the approach that the teacher has, it's the excitement that the teacher has. And if you start in elementary school, you don't burn those kids out. What happens is they burn the teachers out because they want more and they want more and they want more.

**PAT JAMES:** What about when they go home? Do you think it's right to have third-graders have three hours of homework required?

**TONI C. BROWN:** I don't send three hours of homework. What happens if they have the idea and they go home and pester parents?

**BOB EWELL:** My kids do three hours of homework.

**TONI C. BROWN:** That's individual school districts, and I don't know what goes on there. I send some extra things home with my parents.

But the other thing I do — we talk about shutting off the calculators and computers. What happens when the electricity goes down?

I had taught sixth grade for five years, and I could not understand WHY my sixth-graders, when we were doing multiplication and division, could not do multiplication and division, because they can't add and subtract in their heads. They had to have a piece of paper to do it.

So now that I'm in a second-grade class, we do mental math. For example —

**PAT JAMES:** You're to be commended.

**TONI C. BROWN:** Well, I know.

**PAT JAMES:** What I was kind of impressing was the idea that the parents should get involved, and when the kids leave the school, no matter how dynamic the teacher or the classroom is, if they are expected to do, what I wasn't even expected to do in tenth grade or eleventh grade, three hours of homework every single night, the kid can burn out.

**TONI C. BROWN:** The difference there again is if you hand out workbook pages, if you hand out ditto pages, the kids are just doing busy work.

I also teach low reading, and we don't do workbooks. We do things. It's back to teacher education: How do we get the elementary teachers and then the parents to be excited about learning things? And somehow the major problem you have in the Department of Education is to retrain parents, and we may not be able to do that. We have to train the kids we have now to be the parents we need, that will be excited about school. And so it's a combination parents-teacher education, so that the kids get burned out if they have stacks of just stuff to do to keep them busy. But if you train the teachers to, keep the kids excited and to do the mental calculations —.

**PAT JAMES:** I'm 100 percent in agreement with teaching the teachers.

## Why should a parent send their kids to college and pay for remedial courses?

**KEN STEGENTHALER:** That's the point I was wondering. Are you putting any heat on the universities, departments of education? My wife and mother-in-law both were teachers, and my mother-in-law got her Master's later on, and she had gone to a two-year normal school. She's 86, as a matter of fact, today, and her comment was she learned more about teaching in her two-year normal school, 66 years ago, than she did when she went to a Master's program to get her Master's in education. And the comment was that most of the teachers at the university had never taught a student in their life, and they gave you all sorts of theory but no practicality.

And my wife's comment was, when she first went to teach, the first thing that happened was one of the more experienced, older teachers took her under her wing, and even in the short amount of practice teaching, and said, "Okay, you know, forget most of this theory type, here is how you do it. You have to have things for kids to do and you have to have all of these other things." Her comment was she could have almost skipped the four years in college, because she learned more from the experienced teacher than she ever learned in the classroom.

So what good is a degree in education, if you hardly emphasize the teaching part?

**MS. DORSETT:** Well, that is true. In fact, most colleges are now offering remedial courses because students are ill-prepared for college work. Why should a parent send their kids to college and pay for remedial courses.

If parents put the heat on and demand a quality education throughout their children's school lives, students would be well equipped academically to handle a college curriculum.

The secretary is putting the heat on all across the country.

**DR. BOYD BALDAUF:** On the teacher ed, there's a great deal of change going on, and I have been over in computers the last nine years and loved it; but there is a great deal of change going on, and there has been a lot of real, more practical work.

I was a director of field experience and we tried to get them out early, tried to work with them. However, I hope we never get away from the theory, because I think theory and — in our business I was dumped in space force a long time. Theory in our business is important, it's a starting point and so there are certain theories, that they have to have; but also I think a lot of it is done out in the field also. Not all the best things to learn in the field, though, I can guarantee you, about 17 years of that.

Let me just address this homework thing. I'm founder and on the board of a private school down in Pueblo. Needless to say, in a private school we take the math, we take the reading, we take the science competition partly because we have this, the parents pay for it and they're interested in it.

Besides that, this board member is in charge of discipline. No child is going to be abused. No teacher is going to be abused.

And on homework, I think it's terribly important that we start at a young age, and if we have, maybe, a small amount of homework that we do; at least one thing the homework does, it keeps them away from that damn TV, which produces two-dimensional human beings.

I think TV is another part of the problem with education. It certainly is educating them. The kind of TV that's watched in most homes is educating absolutely in the wrong ways.

**MS. DORSETT:** Television is a passive activity; not using their minds at all.

**MS. TONI C. BROWN:** Makes two-dimensional people.

**DR. BALDAUF:** Yes.

**MS. SHANNON HERBER:** I keep hearing all this emphasis on elementary-aged kids, and right now I'm in high school, the next generation to go out. What do you suggest for us to do?

**MS. DORSETT:** Well, the mere fact that you're here, you must have gotten a good elementary-school education to begin with.

See, I don't think that you're having the problems that many of our Americans kids are having in education. You will do well because you probably went to a very fine school.

The problem really is more serious than one can imagine, and we look at it, very critically, because in the next generation, we're not going to have any leaders unless we do something.

All I can say is continue what you're doing, because I think you're doing the right thing by being here.

I was even surprised to find that you were a high-school student, so thank you for coming.

**CAPT. JAMES SPELLMAN, JR.:** We talk about getting the parents more involved, we talk about getting the teachers educated again. What about superintendents, the administrators, the principals?

Case in point, I gave a presentation on a Young Astronauts program. I have been trying to coordinate the activities with some Young Astronauts chapters out there in the Lompoc School District, which is a part of Santa Barbara County in California. Lompoc is right in the shadow of Vandenberg Air Force Base, an excellent training ground for kids to go out and tour the facilities and things like that. The basic reaction that I had when I made the presentation to the principals was, "Thank you very much. That was certainly very interesting. What's the next item on the agenda so we can go home?"

**DR. BALDAUF:** But if the next agenda was about a football game, the coaching fools in the principals and superintendent shop would talk your arm off on it.

**MS. DORSETT:** I can say one thing, that they need to take the politics out of education I don't know if you realize how political education is.

School board members, jobs in schools, who gets those principalships?

It's not all about the best person that can do the job.

And once we can do something about that, I think that will be a great help.

**Are American educators looking to the Japanese, the Korean models to glean anything from their experience and their success in developing sciences and math?**

**DAN DONOHUE:** American industry looked to Japan for different models as far as improving American industry based on their model. If Japan and Korea and some of the culturally unanimous societies in Asia have benefits, what are we getting out of that? Are American educators looking to the Japanese, the Korean models to glean anything from their experience and their success in developing sciences and math?

**MS. DORSETT:** Well, I think we are, I think our parents need to look at how they're parenting their children, and I think that really is the basis. But in education, I know we are studying what Japanese and Korean students are doing, and they are publicly polling some information on that now. I think that I can probably share some of that with you in writing in my office.

**DAN DONOHUE:** Is there anything other than the cultural unanimity? We're a very diverse society here, whereas they're more —

**MS. DORSETT:** They have a longer day, they're in school six days a week. They have a different program altogether. And where we have so many different outside activities, these kids really are focused on the academics, and we're not. We are focused, we feel that it's more important to have well-rounded students, so we have all these other extracurricular activities and the Japanese students don't. I don't know if that's good or bad.

**DAN DONOHUE:** Do they have the same amount of TV access?

**MS. DORSETT:** I don't think so.

**GLORIA MC MILLAN:** You've mentioned several times how important the parenting role is and the education of the parents.

Is there any national program going on that emphasizes parenting training?

**MS. DORSETT:** Well, it's one of my initiatives, anyway.

I have made recommendations to the Secretary on having a national parent conference, not only from the parent perspective, but also to sensitize administrators in how they're to involve parents in the school system. Many parents really are afraid to come into the schools, and they're not well received, and so we need to change our attitudes toward bringing them back into the system.

**It's better for them to give their child a book to read and deemphasize all the materialistic activities.**

I don't know of any initiatives, other than my personal feelings about what should be done with parents, and hopefully we can get something done on a national level. There are some national coalitions of parents, not just the multitude, but they hold agendas all the time. But I do talk to many parent groups and I really turn them on, and I have all these dos and don'ts, you know, because many parents have turned to materialistic objects for their children. They feel it's more important to put sneakers, and very expensive sneakers, on the children and give them one big, big, radio box or a leather jacket, and this is not what should be important.

And.as I talk to them and try to change their understanding that it's not the material things that count. It's better for them to give their child a book to read and de-emphasize all the materialistic activities.

**DR. MC MILLAN:** Actually, I think that it's really important that there be initiatives to focus attention on a role of parenting on a national level that cuts across communities.

**MS. DORSETT:** I agree with you. I'm working at it.

**DR. BALDAUF:** And your preschool education?

**MS. DORSETT:** I'm working on that now. There are some states who are doing quite a commendable job, but from the national level, I did make a recommendation to the Secretary. It worked in my school, I can tell you; parents helped me to change some of those teachers who are so few in that school system, where my hands were tied by the unions. The parents can say things that I can't say. It was fantastic. We did it. In fact, I had one parent, she gave me a gift and it said, "We asked God for help, and he sen, s-e-n, you," and I really appreciate that. I have that mounted in my office now.

Yes.

**PHYLLIS ADAMS:** Several groups are working together in the area of parent involvement. I'm President of the International Reading Association and for a number of years we really have worked through our state and local councils with approximately 250,000 members in the U.S. for parent-involvement projects.

We do have a new project that will be coming out in October working with three other groups, the American Newspaper Publishers Association, the Association of Elementary School Principals, and the National Congress of Parents and Teachers. This project called Family Focus, learning and talking together. As you were talking, it seems like other organizations, your department, if we really could work together in terms of family involvement, I believe we could make a much greater difference than individuals, like trying to frame our way.

**MS. DORSETT:** I agree with that. Thank you.

**I think that we should not pay kids to be educated. They should be educated because they want to improve their own selves and their lives.**

**DR. DUCA:** I think we'll have time for just one more question, and maybe throughout the morning you will have a chance to speak with Ms. Dorsett on a one-to-one basis.

**KATHRYN MARTIN:** I want to get your thoughts on the seemingly new process of paying students to become good students.

**MS. DORSETT:** Well, all I can say, if it works, then we should do what works. I don't think that we should make this a wholesale project, however; but I think that in small communities, maybe small groups of students, probably the most difficult at-risk students — that it might be something that one can try, but I wouldn't encourage this throughout the United States as something that we should do.

I think that we should not pay kids to be educated. They should be educated because they want to improve their own selves and their lives.

**DR. BALDAUF:** Could you just comment if there's any national policy on preschool education? How important it is, and how we should do it, how we should fund it?

**MS. DORSETT:** I really can't answer that question, because most of the preschool programs are funded by HHS, and I know from my office there's no national mandate.

Thank you very much. I enjoyed talking with you today, and if you want to have any other questions, I will be pleased — I will be here throughout the morning. Thank you very much.

# SPACE AND AVIATION EDUCATION PANEL

*Moderator:*

**Dr. Victoria Duca,** Director of Special Projects,U.S. Space Foundation

*Panel:*

**Phil Woodruff,** Director of Aviation Education, Federal Aviation Administration

**Ed Moran,** President, Astronauts Memorial Foundation

**Brenda Forman,** International Space University

**Dr. David Winstead,** President, Challenger Center for Space Science Education

**T. Wendell Butler,** Executive Director, Young Astronauts Council

**Harold Bacon,** Deputy Chief of Staff for Aerospace Education, Civil Air Patrol

**Dr. Robert Brown,** Director of Educational Affiars, National Aeronautics and Space Administration

**Dr. John Akey,** Education Consultant, U.S. Space Foundation

*DR. VICTORIA DUCA became Director of Special Projects for the U.S. Space Foundation in June 1986. In this position, she is the liaison between the Foundation and outside space and aviation organizations and agencies developing programs to extend the Foundation's educational outreach. She also works with other staff members in conducting graduate aerospace educational teacher workshops. Dr. Duca has thirteen years as an elementary, junior high and high school teacher with the Denver Public Schools. She holds a B.S. in Elementary Education, an M.A. in Special Education, and a Ed.D. in Aerospace Education. A certified scuba diver and licensed private pilot, Dr. Duca was selected for inclusion in "Outstanding Young Women in America" in 1986, and "Leadership 80's" of Colorado Springs in 1986.*

**DR. DUCA:** Ms. Dorsett, we are honored that you took time out of your busy schedule to be with us today, and more importantly for taking the time to answer our questions.

One of the points that you made in your presentation is that you felt that science teaching should be reformulated for a hands-on, exciting format, and I think we can all agree aviation and space certainly provides a medium to do that. There's a phrase that you used, Ms. Dorsett, that I really like. I have had people say, "Well, what is aerospace education and exactly what do aerospace educators do?" Now I'm going to adopt your phrase. What I'm going to do is help students explore the universe. I really like that. I feel really honored this morning to be heading this panel. If you look across our panel members here, they represent national leaders in aerospace education. They are people that are really committed to making a difference in our educational scene.

Last night, those of you at the banquet heard Richard MacLeod, our Executive Director, announce that the United States Space Foundation now has the distinction of being the only triple resource center in the United States: a NASA Teacher Resource, a Civil Air Patrol Resource and an FAA Teacher Resource Center.

At the Foundation, we believe that aviation is very important in regards to space. I have heard the phrase used that aviation is a first step into space, and it's all important.

So what I would like to do this morning is start off with aviation, with Mr. Phil Woodruff, who is Director of Aviation and Education at the Federal Aviation Administration in Washington, D.C.

Each panel member is going to give a short presentation, and I would ask you to hold your questions until the very end. Thank you.

**MR. WOODRUFF:** Thank you, Dr. Duca, and thank you to each of you who have taken time this morning to come and be with us.

It's indeed a special pleasure to be again at the United States Space Foundation Symposium and to see so many people. I want to especially acknowledge the U.S. Space Foundation's role in bringing together this group of people who work together to help the fields of aerospace and education.

FAA is pleased, as I said, to be a part of this Space Education Symposium, and especially to see that the Space Foundation and that all of my colleagues in the space world realize the importance and the connection between aviation and space, and that, indeed, aviation is the first step to space.

Our objectives at FAA — simply to improve education. Yes, science, math, reading, language, arts, history, all of those fine things, but also extremely

*PHIL S. WOODRUFF is the Aerospace Education Specialist for the FAA, responsible for planning, coordination, conducting and evaluating the aviation education program of the FAA. In this position , he develops and implements professional aviation and space education programs for elementary, secondary and higher education, as well as airmen, community leaders, and the general public. He is an FAA certified commercial pilot and flight instructor. Before joining the FAA, Mr. Woodruff served as Director of Aerospace Education for the U.S. Air Force's Great Lakes Region to Civil Air Patrol. He holds A.S. and B.S. degrees in Aviation Management from Embry-Riddle Aeronautical University, and has done graduate studies in business, education and law. He currently serves as Chairman of the University Aviation Association's Aviation and Space Education Committee.*

important to us is general education.

Aerospace literacy is our goal: a citizenry that is sufficiently aerospace literate to make logical, rational, informed decisions about aerospace matters in our society.

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We cannot accomplish this task without a partnership with education. It just can't be done. For the education systems, both formal and informal, are the systems and the only place in our society where almost all of the citizens gather for the purpose of learning. Ninety-nine percent of our citizens participate in the formal education system at the Grades 1 through 8, ninety-four percent of the citizens of this country participate in the formal education system, Grades 9 through 12, and thirty percent at the college and university levels. twenty-five percent of the population of our nation is involved full time in the process of education in this country.

As Ms. Dorsett emphasized, the states have a primary role and a primary responsibility in education. We also, in the Federal Government, especially in the federal agencies, FAA, NASA, United States Air Force, and its auxiliary, the Civil Air Patrol, must be involved, because we have Congressional mandates to keep the public informed. We must be partners with each other, and with industry and the private sector, to help educators achieve their goals, as well as our goals.

**We must stop banging on the teachers, we must help them.**

So what are we doing about this issue? First of all, we must take a look at where we are. History tells us that we have every reason to expect immediate results by working together to bring about user friendly programs to the classrooms of America, in all disciplines and at all levels. We know it's been said that those who do not understand history are doomed to repeat it. To accomplish this, we must do the right things, those things which work. We must establish programs, processes and structures which exhibit a sense of priority, order, purpose and cohesion, especially cohesion, and that's what I see happening here today, working together.

This is our philosophy at FAA. Partnerships yielding efficiency. Education must become a national priority in this country. We must stop banging on the teachers, we must help them. Like all people, they want to do a good job, and they work with students who want to learn.

We have many great teachers. I know; I work with them. I work with the students. I see some of the best and the brightest, and I know that many of those are involved in aerospace education. And I have been in the classrooms, I have been at all levels, and I've seen and worked with schools, with as many heart-warming stories as Ms. Dorsett mentioned. After you get through that barrier people in the educational system understand the importance of aerospace, not only to the citizenry, but also what it means in the classroom. It is one of those things that work.

As I read Dr. Bennett's publication on using what works, the hands-on science theories and so forth, I know for a fact that it works, but it doesn't only work in math and science, it also works in the language arts, reading and other disciplines.

A report came across my desk just a couple of weeks ago from an educator in Nebraska, reporting that after integrating aerospace across his curriculum, there was a 54 percent across-the-board improvement in academic achievement. I know that's been done in August Martin High School in New York during the past 15 or 20 years, where they integrated the total curriculum with aerospace focus. The school changed from a dumping ground for Blacks and Hispanics in the New York City public school area to become one of the top achievers in the New York City Public School System. The California reports, and many other examples also show these changes.

We must work together to bring these messages, programs, and activities to the schools.

We must determine the proper roles of the Federal Government, of the States, the communities, the administrators, the teachers, the parents and the students. We must be positive, and we must be receptive to change.

If there's one thing I notice in working with schools, it's a lack of willingness or capability to change, and that's the same with industry, it's the same with government.

We can learn a lesson from Socrates, one of the greatest teachers of all times, he viewed his duty to educate in the same light as his duty to defend. For without an educated society, we will not maintain our nation.

If the federal government will assume the leadership role, and if the states will perform their roles, the communities and the schools, and the teachers, and the parents and the students will perform.

We've drifted from our missions, our basic fundamental missions, the back-to-basics in education, the back-to-basics in pilot training, the back-to-basics in everything. I hope we can all get back to the basic fundamental missions that we have, as federal agencies, education and industry working together.

FAA is focusing on the importance of an aviation-literate society. That is absolutely crucial and critical to our success in performing the fundamental basic mission of our agency, to promote and facilitate air commerce, air safety, and national defense.

NASA promotes space literacy. The Air Force promotes aerospace and defense literacy. The Department of Education, as the catalyst promoting educational literacy in all areas, can benefit and contribute to the states, the agencies, the industry. Let's all start working more closely together.

Politics was mentioned this morning. I submit that if we spend a great deal of energy trying to remove politics from education that we're wasting a lot of our time. Politics in education are like politics in everything else.

We must acknowledge that our society involves a political role and process, and rather than try to remove that, let's try to work together to use that to our advantage.

There are many success stories in that area and I think, working together, we can accomplish those goals.

Just a moment on some of the programs headlines of what FAA is doing and is planning to do in the future. With budgets and deficits the way they are, it's not possible to do all of the things that we would like to do, but it is possible for us to see how we can most prudently apply those resources which are available to us, to the most appropriate roles and priority roles that we have to stimulate aerospace literacy in our society.

Working with our system of regions and centers (we have nine regions and three centers, a technical center, an aeronautical center, and a center for management development) we will have a new thrust of aviation education program development. The technology from the centers are gathered together, and the scientific capability of our agency is applied to developing programs which are user friendly to the school systems, and user friendly to the classrooms, and the teachers. These tie into the basic core curriculum of education with messages that both enrich the subject matter that is being taught, and bring about a general understanding and a level of education that will help our citizens become responsible decision-makers.

**We must acknowledge that our society involves a political role and process, and rather than try to remove that, let's try to work together to use that to our advantage.**

Networking developments.

I'm very proud of the results of the efforts of Dr. Brown from NASA, Mr. Bacon of USAF-CAP, and I have gleaned by working together to form a formal partnership to participate together in bringing about aviation education and space education programs to our nation.

We'll continue to work with industry and other associations, state education leaders, state aviation leaders and space leaders to encourage and assist the states in developing programs which are appropriate for their systems.

I have mentioned the schools and colleges.

**The United States Space Foundation is taking the leadership role in this, and for that they are to be congratulated.**

One of the areas that we're working on with the Space Foundation, is the textbook industry. Over many years, people say, well, the textbook industry doesn't care about aviation or space. They just want a picture of the shuttle or a picture of an airplane on the cover of the book and nothing in between. Through a process of exploring and research we learned that they are interested. They just don't have the technical capability, nor do they have the financial resources.

So partnerships have been formed with education, government and industry which will cause the aerospace education concepts to be tied to the various disciplines in the textbook and the curriculum over the next few years. The United States Space Foundation is taking the leadership role in this, and for that they are to be congratulated.

We know that 90 percent of the teachers teach 90 percent of the time right out of the textbook, and if we can begin to integrate these concepts with the basic core curriculum, then we can add other enrichment programs that will help get across the concepts that we are hoping for. For the young people who enter first grade next year will graduate from high school, or at least 75 percent of them, according to today's statistics, in the year 2000. They will be voters, in that year's election, so we hope that there will be a greater level sense of responsibility among those citizens who will begin to take over the leadership role.

At FAA we sponsor many special projects. We work with every possible organization that we can to provide assistance and help them accomplish their goals in aerospace education. We do not try to make it all our agenda, but what they want to accomplish, and in the process, our message gets across.

We're working heavily with public and community education to stimulate activities, partnerships, and networks. We want to form critical masses at the community level interested in aerospace education. They will introduce concepts to the school systems and develop a sense of responsibility of how they can establish true and meaningful partnerships. If it doesn't happen at the community level, if it doesn't happen in the classroom, all of the things that we do in Washington and at the state level are for naught.

Information sharing, clearinghouses, applications of higher technology to our programs are all important parts of our program.

If I may take just another minute to emphasize why I feel that it is important for all of us to become more aviation literate and give you an example, the FAA example, of our concern.

Today as I'm standing here — looking at a society which has placed upon the United States Aviation System a demand which far exceeds the capability in many cases.

The public demand for aviation services, passengers, cargo, so forth, has doubled in the past decade, and it will double again by the year 2000.

Airport capacity is a major issue. Where do we land the airplanes to take the people and the things to the places they want to go? We do not have as good of a public base, as good of a public education base and awareness as does NASA. We haven't committed the resources to do that, nor have we committed the resources that the Air Force and Civil Air Patrol have. We plan to do that. The FAA Administrator, Allan McCarter, has aviation awareness and education as one of his very top priorities, and with him as a champion at the top, we will get a lot of things done. I think we will be able, in the future, to see a more literate society, academically, and a society with a greater aerospace awareness to help our country maintain superiority in all of the areas to which we aspire.

Thank you very much.

**DR. DUCA:** Thank you, Phil.

We're next going to hear from Mr. Ed Moran, who is President of the Astronauts Memorial Foundation.

*EDWARD J. MORAN was elected President of the Astronauts Memorial Foundation (AMF) in September 1987. Mr. Moran serves as the Foundation's Chief Executive Officer and a member of its Board and Executive Committee. He received his undergraduate degree from Hillsdale College and attended the University of Michigan and Notre Dame Law School as a graduate student. Mr. Moran's experience spans twenty-five years and includes management positions in business, government and the non-profit sector. In the non-profit sector, Moran served in higher education, medical and health fields. He most recently was Vice President National Development of the National Multiple Sclerosis Society. While on leave of absence as Assistant to the President of the College of the Virgin Islands, he served as Executive Assistant to the Governor of the Virgin Islands in 1969 and later as Executive Director of the Territorial Legislature. Mr. Moran served in the Army on two separate occasions and received a field commission during the Korean conflict.*

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**MR. MORAN:** Thank you, and good morning. I would like to take this opportunity, certainly, to thank Dick MacLeod and the U.S. Space Foundation for not only putting on a superb symposium, but for the excellent hosting that has taken place during this time.

Just by way of background, my professional career has been in the nonprofit world for almost thirty years. Most of it was in college and university work, although I started out teaching in high school and junior high school, I have also had the good fortune of spending time in the corporate sector and in government, so I've been exposed to most of the facets that I think all of the speakers so far have addressed.

I've often said to myself, which certainly many of you have too, if I only had the opportunity to take an organization from the beginning — wow! What I couldn't do with it, especially in the field of education. I thought that many times. Little did I know I would have that opportunity.

I joined the Astronauts Memorial Foundation in September as its first full-time elected President, and this Foundation is relatively new. It's two years old, and it was created for the purpose of building a Memorial at the Kennedy Space Center to honor all fourteen astronauts — you certainly know about the Challenger group and the others — but there were also four astronauts who were killed in training accidents: Charlie Bassett, Elliott See, Clifton Williams and Theodore Freeman. So one of our goals was to build a Memorial at the Kennedy Space Center for these astronauts who indeed gave their lives in the line of duty for our country's space program.

But the second half of our mission is to develop an education program to enhance the understanding of space and space exploration.

The Foundation is a 501(c)(3) tax-exempt organization that depends on gift support, as does the U.S. Space Foundation, to carry out its mission, and I am pleased to report to you that we've been fortunate to build a very strong financial base during the first two years of operation. We have raised something in excess of four million dollars thus far, and the programs that we have would indicate that our long-term financing will be very good.

I hasten to add, however, that AMF is not a grant-making organization, for those of you who are looking for financial support. Our staff is relatively small and probably will not exceed 12 to 15 people, but in large measure, that will depend primarily on the thrust of our education program.

On Wednesday morning I presented a progress report on the status of the Memorial, so I won't repeat that information here. My purpose this morning really is to share with you the status of our education program, the principal focus of the Astronauts Memorial Foundation.

Last November, we began a year-long study to determine the specific educational focus of AMF. That study is to be completed in November of 1988, with a report containing recommendations submitted to our Board of Directors at their annual meeting in December. Obviously, we hope that in January, 1989, we will begin to implement Phase 1 of our education program.

The only self-imposed restrictions we established for the study are three.

First, insofar as possible, AMF does not want to duplicate what other organizations are doing, recognizing, of course, that there may be some overlap. We recognize also that there may be areas that could use the attention of more than one organization, but at the present time, we feel that that may not be the best use of our resources. However, we're learning that there are some specific areas of concern that are receiving little or indeed no attention.

Second, we will only undertake programs that we can do and do well within our resources.

And third, the program will be national in scope, or have application on a national basis.

During our planning phase, it soon became apparent that we would have to be able to answer some rather obvious questions if the results of the study were indeed to provide the Foundation with some direction. What is being done now in our educational system to broaden the understanding of space and space exploration and the impact such exploration will have on our civilization? Who is doing it? What yet needs to be done? And, of course, what resources are needed to get the job done? These are very fundamental questions, but they have to be asked.

**Man has made the conscious decision to leave this planet and did... This single act has, and will have greater impact upon the face of this earth than all the civilizations and kingdoms of the past.**

In order to provide the answers to these questions, we began by convening two national task forces on separate occasions. They included representatives from the educational community, the aerospace industry, government, and the media. Among these groups, we were fortunate to enlist such people as Neil Armstrong, Dr. Robert Brown, one of our panelists here from NASA; Dr. Putnam Ebinger from Georgetown University; Chris Little, the president of Newsweek Magazine; Charles Walker, an Astronaut Payload Specialist from McDonnell-Douglas; Dr. Kenneth Wiggins, Oklahoma University; Gen. McCartney, Director of the Kennedy Space Center; David Webb, who you know is here at the Symposium and member of the President's Commission on Space, Dr. John McLucas, Michael Michaud, Acting Deputy Assistant Secretary for Science and Technology Affairs, U.S. State Department, and people of that level.

On two separate occasions it was, a very prestigious and hard-working group of individuals. I might tell you that the process will continue until we actually develop the report. This process includes talking with many knowledgeable key people around the country.

In addition to getting a handle on what other organizations, educational institutions and governments are doing or not doing, as the case may be, we have begun to develop some rather interesting information, which is certainly food for thought for the Astronauts Memorial Foundation as it charts its educational focus, and it might be interesting for me to share some of that information with you.

Consider, if you will, for the first time in the history of mankind, in the history of the world for that matter, man has made the conscious decision to leave this planet and did. This single act changed the course of our civilization for all time, forever. We can never turn back. This single act has, and will have greater impact upon the face of this earth than all the civilizations and kingdoms of the past. All the achievements of the great explorers — Magellan, Columbus, and yes, all of the wars we have ever known. Is this a historic event? Obviously that's the understatement of the century. However, as I travel around the United States for our Foundation studies, I am struck by how few people are aware of the impact of this significant event, during history and in our lifetime, in terms of what impact it will have on us.

Consider something else. Americans who were born at the time this nation's space program was formally organized, give or take a couple of years, are now 31 years of age. There were slightly more than four million Americans born at that time. I checked it. Chances are that most of them have heard something about our space program. If they watch television, at least they know a man walked on the moon, and they are aware of the Challenger tragedy. But in terms of how our nation's space program will impact their daily lives, their children's and their grandchildren's daily lives, and indeed our civilization, the majority of them are probably functionally illiterate about space. The educators who taught these four million people are probably retired now, and probably know or knew less about the impact that that would have on our civilization.

> **"Think of the American classroom 50 years ago today." Interestingly enough, there isn't all that much change.**

Of these four million people, 935,000 graduated from college in 1980. Slightly more than 118,000 received teaching degrees. I suspect it's rather safe to say that the majority of them also are functionally space illiterate. Be that as it may, they have been teaching for eight years, and most certainly will be teaching the children who will become 21 by the year 2000. Incidentally, all of those individuals have already been born.

What concerns me is that the cycle appears to be continuing. There is little evidence that our national leadership has taken any real note of the most significant event in history, of our civilization — man's decision to leave this planet.

I want to put that into a little perspective. I was particularly struck by a remark that Dr. Brown made, as a member of our task force. He said to the group that was assembled, "Think of the American kitchen 50 years ago."

I grew up on a farm for part of my life. We had a wood-burning stove, a pump on the sink and used kerosene lamps, and that's not all that long ago.

He said, "Now take a look at the American kitchen today. If you spend any time near the burner or the microwave, you know there has been dramatic change in the American kitchen."

Then he went on to say, "Think of the American classroom 50 years ago today." Interestingly enough, there isn't all that much change. I think the black boards are now green and the chalk is yellow, but essentially, it's the same.

I wonder what the American classroom is going to look like in the year 2000? That's only 12 years away. In the year 2000, our space program will be 42 years old. Where are we going?

It seems quite obvious to me, and to others, that in addition to developing more mathematicians and more scientists, which we desperately need, we must also spend an equal amount of time on teaching young people how to cope with the change that has been brought about as a result of this historic event. Because surely they're going to have to cope with it, as we are trying to cope with some of today's issues.

The question to which I cannot seem to find the answer, as I travel around the country, is who is dealing with the issue? Who is picking up the challenge? Some of the organizations are represented right here.

> **In the year 2000, our space program will be 42 years old. Where are we going?**

So, having developed that information, it is not surprising that our study is beginning to indicate that there is a tremendous need at the undergraduate level, especially at those institutions that prepare young men and women for the teaching profession, to help develop an understanding by faculty of the change our civilization is undergoing; how to use space and all the things that it represents in the classroom.

It is equally important to help these faculty members convey to our future teachers of America the need to know how to help the children learn understand the benefits of space, and how to cope with this change that we are going through at the present time.

Our study is also beginning to show that not much thought has been given to these areas, and that there is a need for educational research and research application.

Obviously, these issues will not be resolved overnight. We don't see any quick fix, or band-aid approach. However, if properly addressed, the results could be of major significance to our educational system. For these reasons, the Astronauts Memorial Foundation is taking a very careful look at all of these particular areas.

In closing, I invite you to participate in our study process by sharing your recommendations and your suggestions for us to consider.

We are still in the study process, and that will go on until probably October, when we will begin to formulate a written program, but obviously, once the program has been created, we will concentrate our resources. I would like your input and I would like to hear from you.

Thank you very much.

**DR. DUCA:** Thank you, Ed.

Those of you that read our monthly publication from the Foundation, the "Space Watch," will recognize our next panelist, Dr. Brenda Forman. Since she wears several different hats, I'm going to let her explain which hat she's wearing this morning.

*DR. BRENDA FORMAN joined the Lockheed Corporation in October of 1983 as Corporate Director, International Marketing Policy. She took her B.A. at Barnard College in New York, and holds a Ph.D. in Political Science from the City University of New York. Dr. Forman came to Lockheed after five years at the Commerce Department, where she was the Director of the Division of Policy Planning in the Office of Export Administration. During her last year at Commerce, she was Senior Technology Policy Advisor under the Assistant Secretary of Commerce for Trade Development. From 1973 to 1979, she was a senior analyst in the Office of the Secretary of Defense, Directorate of Policy Planning, International Security Affairs, where she worked on major policy issues in the areas of security assistance and East-West technology transfer. Earlier, she had spent four years at The MITRE Corporation in Washington, D.C., as a member of the Technical Staff, working on a wide variety of projects for various elements of the Defense Department. She is a member of Phi Beta Kappa and a recipient of the Department of Defense Distinguished Civilian Service Award.*

**DR. FORMAN:** Those of you who looked at the program for the very first day of this Symposium saw me attributed to the Lockheed Corporation, and that is, in fact, correct. I'm the Director of International Marketing Policy at the Lockheed Corporation.

But this morning I'm wearing a different hat, speaking for International Space University. My corporation has made me their contribution to ISU (International Space University) for its first summer session, which is going to be hosted by MIT this summer.

Originally, I was to be ISU's Course Director in Space Policy and Law. Now by some curious alchemy, I have also become Head of Faculty.

Let me tell you a little bit about ISU, since probably very few of you have any idea what it is. It is brand new. It is the brainchild of a trio of incredibly high-energy young men in Cambridge who decided that there was an unoccupied niche on the educational scene these days that pertained to international and cross-disciplinary education in space.

**But space, like every other marketplace and industry in the world, is becoming daily more of an international undertaking.**

The people and the programs you have been hearing from and about this morning are by their nature, and often by law and regulation, limited to the national boundaries of the United States, and that certainly is a fertile ground needing much effort. In that connection, I have been really impressed by what I have been hearing this morning. But space, like every other marketplace and industry in the world, is becoming daily more of an international undertaking. This is not because there's been any rise in international brotherly feeling It's because there's not enough money around, and therefore, nations are unwillingly deciding that maybe they need to cooperate here and there in order to get the job done.

This trend towards internationalization is occurring in more industries every day as the world market inexorably becomes globalized. It's happening in aerospace, in automobiles, and any number of others that you can tick off one by each, and it is also increasingly a characteristic of the space industry.

So what ISU is looking to do is to gather an initial cadre of about a hundred graduate and post-graduate students from all over the world, and expose them to an intense curriculum that cuts across disciplinary boundaries to cover a broad spectrum of eight curriculum areas. I'm heading up Space Policy and Law. In addition, there is Space Architecture, Engineering, Satellite Applications, Life Sciences, Business and Management, Space Sciences, and Manufacturing and Resource Management.

The idea is that all of the students, no matter what their primary specialty is, will be required to attend all of the courses in all of the curriculum areas. Then in addition to this, they will take part in a design project whose scenario posits the formation of an international consortium to build a permanent manned outpost on the moon. Each one of the students will, participate in a simulation of all the many factors involved in building that base.

**I don't think that any United States government entity would have been able to reach this far abroad because that would have involved spending U.S. taxpayer money to support foreign students, and the Congress isn't likely to let you do that.**

We had our second faculty conference about a month ago at which we went over all the applications. They had come from everywhere in the world, including some pretty surprising places. We were really impressed by the caliber of applicants we got. There were 350-odd applications for 100 slots and we wondered, "Well, gee, how much dead wood is there going to be in here?" Surprise! Hardly any at all. In fact, it was really hard to choose among such an embarrassment of riches. But eventually, we narrowed it down to 105 students from 20 countries. And you'd be hard put to find another batch of such overachievers. I don't think that any United States government entity would have been able to reach this far abroad because that would have involved spending U.S. taxpayer money to support foreign students, and the Congress isn't likely to let you do that. ISU, however, was able to solicit — and receive — funding from all over the world. A lot of U.S. organizations probably wouldn't be allowed to accept foreign funding. Well, we'll take money from anywhere, thank you, and if there's anybody in this room interested, we will gladly take names!

We hope this first summer session will become the germ of an international space leadership cadre. My irreverent term for it is "space ring-knockers." You know that term? West Pointers are called ring-knockers because when you're in an officers' club and you want to advertise where you came from, you go whap, whap, whap on the table with that big West Point ring, and that indicates that you're a "Pointer." So this is my flippant term for who I'd like these kids to be.

But it's really a serious goal. The idea is that ISU's successive classes will gradually become a network, crossing both national and disciplinary boundaries, to form a nucleus of international space leaders, people who know each other, who have shared this intense educational experience, and who share a passionate interest in the space programs of both their individual countries and of the entire world.

It's a grand experiment, and I think one that is eminently worthy. I hope great things will come of it. And if you invite me, I'll come back next year to tell you all about it.

Thank you.

**DR. DUCA:** Dr. June Scobee was not able to be with us this morning for the Challenger Center for Space Science Education, but Mr. David Winstead, who is President of Challenger Center, is going to fill in for her. David?

*DAVID WINSTEAD was recently named president of the Challenger Center. From 1981 until the summer of 1987, he was executive director of the Washington/Baltimore Regional Association, a nonprofit alliance of businesses. From 1979 until 1981 he was vice president of the organization. Winstead, 40, worked as a special assistant to U.S. Senator Charles McC. Mathias Jr., R-Md., during the mid-to-late 1970's. In the early '70's, he was a real estate financier for James W. Rouse & Co. Inc. in Washington. The new Challenger Center president holds a law degree from Catholic University's Columbus School of Law in Washington and a graduate degree in business administration from Columbia University in New York. He is a member of organizations including Columbia University Business Associates, the Federal Bar Association, the Greater Washington Board of Trade and the Maryland Industrial Development Association.*

**MR. WINSTEAD:** Thank you, Tory, it's very nice to be here. On behalf of June, I extend to you and Dick her regrets. She got held up on a personal matter in Washington and was unable to make it.

I know many of you over the past year and a half, have had an opportunity to hear June on behalf of the founding directors and Challenger Center. I also know that many of the teachers in space, have been receiving a great deal of materials from Dick Methia, who is our Director of Education at Outreach, and hopefully attending some of the conferences that are already scheduled for the coming year.

The thing that I'm impressed about, not only the Symposium, but the ability of the U.S. Space Foundation to have a very high quality of participants, both in industry and in government, space and astronautics, and also in education.

I think the panel this morning is an excellent example of the type of partnership and the kind of cooperative nature of our joint efforts.

**We have to work together, that we have to take the resources that we have, we have to take the causes that we represent, and we have to take the message of the needs in education, using aviation and aerospace as a stimulant, to the American people.**

You all heard Doug Morrow over the last two evenings, and both times I was very inspired by the ability of a man like that, who's created a message about the benefits of space, to be so honest and to be so upfront about the challenges, both in terms of the deficiencies in the past, as well as the challenges in the future. I think that he came through with a very strong message to all of us, that we have to work together, that we have to take the resources that we have, we have to take the causes that we represent, and we have to take the message of the needs in education, using aviation and aerospace as a stimulant, to the American people.

Much has been written about the decline of America's position; the nation that once was predominant in the world, some observers declare, really lost its competitive edge in a whole range of skills. Americans, once the leading problem-solvers, cannot solve the problems that accelerated world competition has created. American education, they said, the primary shaper of our democracy, had lost its edge in preparing each new generation to confront the challenges of competition.

Ms. Dorsett mentioned the **Nation At Risk**, which pointed out very specifically that we cannot reclaim the education leadership that produced economic, technological and political leadership without all of our help, and without a national consensus. That claim in **Nation At Risk,** produced a great deal of heat and, indeed, some light; states moved to strengthen public education; school boards sought to promote excellence; merit was to be rewarded and competence improved, and more focus was to be put on science and math — the heart of the American technology.

In early 1986 an event took place which seemed to really crystallize our nation's predicament. The Challenger, Shuttle Fight 51-L, containing six of the nation's most able space scientists and one much-loved teacher, exploded shortly after its launch. Many of us witnessed that and will never forget it, and I think in terms of our role in education, for the first time, many of the nation's youth and students experienced death in a very shocking and a very realistic manner; yet, those who know America and Americans know that from tragedies like that, new beginnings are started.

There are many still alive in the late '80s who have seen the nation recover from unprecedented economic disasters, from the ravages of worldwide wars, and from the failure of integrity of political leadership.

It is in this spirit that the families of the Challenger astronauts have developed and supported the concept of the the Challenger Center. The mission of the Center is essentially to complete the mission of that crew, which was to explore, to research, to educate, and to fortify the basic American skill, which is problem solving.

The Challenger Center has been conceived, and it is now being developed, as really an education network whose purpose it is to create unique learning environments in which teachers learn to teach better and students learn to more fully, appreciate the fundamental nature of math and science and technology, using the conditions of space as a motivator.

**Those who know America and Americans know that from tragedies like that, new beginnings are started.**

Over the last year, a great deal of effort has been put into developing our strategic plan for the next five years. Primary goals and specific goals over these years stress equipping teachers with new materials and techniques based upon Challenger Center environment and experience; to motivate and teach students to think critically, improving their problem-solving skills, engaging them in cooperative experimental learning, using simulations of space living and working environments, and to raise, obviously, the public awareness of aerospace as a tool for stimulant in the classroom.

You all heard last year from June the nature of this network of interactive learning centers around the country which we are now creating. I'm very pleased to say that over the last six months we not only have a prototype underway in Houston, Texas, of this space station environment, which will be opening in June for work with students and teachers in the Houston area, but we now have four science centers around the country already committed to be affiliate sites of Challenger Center over the next year. These sites, as well as our headquarters in Washington, will be laboratories where innovative educators can congregate to generate new ways of implementing space education tools.

The thrust of this network, which will reach 25 to 30 science centers and school districts nationwide by 1992, is being driven from a headquarters site in Washington, which June spoke of last year: the Space Life Station of the Challenger Center Flagship Building.

As a way of update, I should tell you that the process is going quite well on that, in terms of both site selection and in terms of design. Over $3 million have been collected to date towards the design work. Sites in both Maryland, Virginia and D.C. are under analysis by a very interesting group of our Washington committee looking for the appropriate location of this facility, which is an education institution, a memorial to the Challenger crew, as well as an innovative hands-on science exhibition hall which will be a portion of the Center itself.

The committee which is looking at the site and the design, is headed up by Leo Daley, who's the Chairman of the Board of Regents of the Board of the American Architectural Foundation and includes Martin Harwit, the Director of the Air and Space Museum and the Head of the National Teachers Society; Jim Beggs, as previous head of NASA; Holly Cantus, the head of Communications for NASA, and many others.

We hope that within a month most of the legal constraints or legal hurdles that we're going through in acquisitions will be settled, and we'll be able to announce that site within about sixty days.

In addition, as I mentioned, there are outreach, programs, and throughout the country the Teacher-in-Space program is continuing, which was merged with the Challenger Center, and that also is progressing extremely well.

In July of this year, we have our first National Teacher Training Conference in Houston, Texas, which will be at JSC; and in addition, in May of this year, through Air Space America in San Diego, there's another teacher conference which is being supported by the Challenger Center. The potential first, I think, is to concentrate on the curriculum and the design of the simulation which will be taking place in the centers themselves, and a very excellent board of advisors is now working in Houston on this prototype site. In addition, we have added an academic board, and also corporate leadership to guide our fund-raising. Some of these that are being involved now are the head of Johns Hopkins, Dr. Muller, the Chancellor of UCLA, Hans Mark; Chancellor of University of Texas and others, all of whom have had a great deal of involvement in aerospace education experiences over the last five or seven years. In addition, corporate leaders, such as Bob Anderson, Manny Fienakis of Fairchild; Alan Paulsen of Gulfstream Aerospace, and about ten others will be added to the board over the next year.

I brought today a copy of the literature which is being produced by the Challenger Center. Not only has the education membership increased, we hoped by the end of this year that the Teacher-in-Space, and conference and attendance in NSTA would too. A month ago, that will have about 1,400 teacher memberships. In addition, through the Space Ambassadors Program, started by NASA and now being administered by us, we will have, as I said, two teacher-training conferences scheduled by the end of the year. And in addition, we've established Challenger Center fellowships, $5,000 fellowships to be given by us to innovative teachers, each one which is basically being given in memorium for one of the crew members of the Challenger shuttle.

Our publications are out, our first edition of the newsletter as well as a copy of "Teachers Touching Tomorrow," which Gloria McMillan is publishing. It will be released in May of this year. A National Public Awareness Program is also being driven out of the headquarters in Washington.

There's an awful lot more that I would like to fill you in on, but for the purpose of the panel discussion, I would be happy to answer questions later. I think the important issue that the mission, which the family started on a year ago, is indeed taking shape. It is not an easy task in terms of funding a program of this nature, but we think that taking these space-station experiences and creating the simulation and the teaching and learning environments is a very forceful message, reaching through America and creating a very complementary tool to a lot of the other efforts going on by the agencies and other groups we heard this morning.

We hoped, as I mentioned, by '92 to have around 30 science museums, and school districts connected and impact about a half a million students a year with the Challenger Center experience, and that's independent of the teacher-training programs, as well as materials that will be used by those teachers in the classroom. We welcome your involvement, as I said.

There are immediate ways in which you can participate, both in membership and our conferences too, in the next three months, as well as in these workshops, and I encourage you all to get down to Houston in the very near term to see exactly what is occurring in the prototype there, which will be opening in June.

I thank you very much, and I will be happy to answer any questions after the rest of the panel. Thank you.

**DR. DUCA:** Thank you, David. I strongly encourage and urge you to pick up some of the Challenger brochures in the back, and if you know of anyone who would be interested in the fellowship, please pass it on to them, because it's an excellent program.

Our next panelist is Wendell Butler, who is the Executive Director of the Young Astronauts Program in Washington, D.C.

**MR. BUTLER:** Thank you, Victoria. This is my third conference, and I always look forward to visiting and participating in this conference.

I would like to add my thanks and commendation to the Space Foundation for always doing a fine job. There's a lot going on here, a lot to be said, a lot to share, and a lot to learn. I'm sorry that Ms. Beryl Dorsett left because I wanted to tell her that I was particularly inspired by her remarks. I was going to tell her what some people told me when I worked in the Reagan Administration for the first term. They used to say, "You make so much sense; how could you be working for this Administration?"

*T. WENDELL BUTLER is currently Executive Director of the Young Astronaut Council. Mr. Butler was instrumental in the original design of the program while working in the White House. Since assuming the role of Executive Director in the fall of 1984, he has succeeded in establishing over 6000 chapters across the United States with a membership exceeding 250,000. While at the White House, Mr. Butler served as Director of Corporate Liaison in the Office of Private Sector Initiatives. His White House post was only one part of a distinguished career of service to the federal government. From 1976 to 1982, he served as Deputy Administrator of the Economic Regulatory Administration in the Department of Energy. Mr. Butler also held positions with the Cost of Living Council, the Office of Management and Budget, and the National Security Agency. A native of Laurel Grove, Maryland, Mr. Butler served as an Air Force Communications Officer for three years in Italy, Germany and Greece. Mr. Butler holds a Master's degree from Harvard University and a B.S. from Howard University.*

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I feel obliged to give you a report card, kind of a status report. It's been one year since I was here, so I would like to tell you what our organization has done in the past year.

I went to the Soviet Union. I toured their space facilities. I visited their schools. I stayed in their homes. I went to Japan twice. I visited their schools, their space facilities. I went to Korea. I went to the People's Republic of China. I met with the Ministry of Astronautics in Beijing, and I went to Australia.

I think those travels confirmed one thing. In the past year there has been a plethora of reports about the status of education in America. My travels confirmed those successes in education in other countries, and the failures in America. It really makes the problems more real, once you've seen them. We have just one goal at the Young Astronauts Program, and that is to get as much teacher friendly, high-quality, hands-on curriculum into as many schools as possible, so that all children, not just the extraordinary child but the ordinary child, can share in the excitement of learning with space as a catalyst.

My travels have convinced me that the direction of our program is on target. Let me give you some comparisons about our growth.

Last year, when I was here, we were in 12,000 schools; this year we're in 22,000 schools. Last year, we had 252,000 young people in our program; today, we have 520,000. Last year, we were in grades one through nine; this year we are preschool and kindergarten through the ninth grade. I will talk more about that later.

**In the past year there has been a plethora of reports about the status of education in America. My travels confirmed those successes in education in other countries, and the failures in America.**

We did one very important thing last year that pleased me personally. We targeted some urban school districts. We received on loan from the U.S. Department of Education a person who knew urban districts very well, and she helped us penetrate some of those school districts that had been most difficult to penetrate. We targeted New York City; Camden, New Jersey; Washington, D.C.; Houston; Dallas; Los Angeles; St. Louis, and the results were rather dramatic. We found that the space program meant just as much to those children as it did to their suburban peers and counterparts.

We found that those districts were more difficult to penetrate, but once you got to the child, the reaction, the excitement about learning, that all the other panelists have talked about, was exactly the same.

Also during this past year, we've formed three very important partnerships - our first partnership with government. We formed a partnership with the Department of Health and Human Services to develop, to test and to implement a preschool program.

We received a grant of $150,000 from HHS, matched it with $150,000, and with that grant we hired some preschool curriculum development specialists. We went to the State of Florida, and tested the program with preschools. Once again we found that three and four-year-olds were just as turned on by space as their older brothers and sisters.

We have begun to implement that curriculum package in the nation's 12,000 Headstart Centers that serve about 400,000 children. Next year, I hope to be able to give you some results of that. The implementation is just starting.

We did try something new and different with the Headstart package. We created a parent component. Many people have talked this morning in the question-and-answer session about how to involve parents. Our educators came up with an innovative approach of creating 30 activities for Headstart teachers and children, and 30 complementary exercises for the parents. So, for example, a young child may learn about the moon and stars in their preschool class in the morning, and then take home a page that accompanies each activity for the parent. It has background notes: just as we prepare background notes for the teacher, it has background notes for the parents. It tells them a little bit about the space program. It tells them a little bit about the activities in which their child participated in class that particular day, and it says to a parent — for example, your child should be able to identify the moon, the stars, the Big Dipper, et cetera. We're looking forward to the successes of that program.

We've just enlarged that partnership with HHS and Columbia Pictures. We're producing a series of 12 videos about space-age education, which, with the aid of Columbia, we will be disseminating nationwide.

We have a proposal pending before the Department of Education to enlarge the urban district targeted program that I spoke about earlier; and finally, we completed the first step of a pilot program with HUD. We developed the program for the children of residents of public housing. The pilot program took place in Washington, D.C., in the Kenilworth area. Three schools started a summer program with a grant from HUD. We developed the curriculum materials. HUD provided the money to hire the teachers for the summer, and we had great success. You may have read about it in the Washington Post in the last couple of weeks.

We're coming up now, on the 1988-89 school year, which would make our fourth year in this business, so I think we're here to stay, and we are beginning to plan for next year's curriculum. We will choose as our theme the new National Space Policy, so we will tie our curriculum materials to the direction that America is headed in space.

I'm going to direct the last few minutes of my comments to my colleagues on the panel. Some of the things that I'm going to say may make some of you uncomfortable, but they need to be said.

Over the past two years, we have been a little frustrated about the fact that the space program has been on hold. We have criticized NASA, if not openly, then in private, in our own circles, because the space program is very, very important to each of our organizations. Our organizations rely on the excitement of space to excite kids, and so we have had to struggle in the past two years to keep that level of excitement up in many cases.

I think with the exception of NASA, all of us here are essentially nonprofit organizations, and we have to raise money to subsidize the development of our materials, so we're all anxious to get the space program going again.

In my own case, the Challenger accident had an unusual effect on us. It caused a surge in the growth of our membership.

**Is it not true that we have focused too often on children who usually have access to aerospace materials, and have, for too long, neglected those children who need it most, those millions of young children in our urban areas?**

We had 6,000 schools in the program at the time of the Challenger accident, and now we have 22,000 schools. But the corporate commitment backed away because I think the corporate community had some doubts — those consumer companies outside the aerospace community, many of whom we rely on — had some doubts and still have some doubts about NASA's ability to get the program going again. So we've had to work doubly hard to deliver the expectation which we created in our children.

I was very happy to hear Dr. Fletcher's remarks. I know that Bob Brown and all the others at NASA are working very hard to get the space program back on track, and we can't wait.

But I wonder if those of us on the panels who have criticized NASA have held ourselves up to the same level of scrutiny. Is it not true that we have, in many cases, duplicated our resources instead of sharing them? Is it not true that too many of us have been engaged in similar activities, instead of sharing activities? Is it not true that we have gone to the same corporations asking for dollars instead of pooling our efforts? Is it not true that we have stumbled over ourselves over the past two years in our efforts to memorialize the Challenger crew? Is it not true that we have focused too often on children who usually have access to aerospace materials, and have, for too long, neglected those children who need it most, those millions of young children in our urban areas?

Is it not true that we have lobbied, individually, the Congress for a stronger space program instead of pooling our efforts on the Hill and in other circles around the country? And is it not true that some of us are talking about building our own headquarters instead of pooling our resources and learning together?

So I would like to issue my colleagues here on this panel a challenge, that by the time we meet next year, we resolve to take these scarce resources that are needed and to pool them and to share them and to share our talents to a much greater extent than we do now, so that we can bring the excitement of space-aged learning to all children in America.

Thank you

**DR. DUCA:** Thank you. We really appreciate your challenge, and I'm sure in the next year the networkings that will be done will be moving closer to your challenge.

**Mr. Harold Bacon has been in aerospace education longer than anyone else. The Civil Air Patrol has been around for close to 40 years.**

***HAROLD R. BACON has a scientific background ranging from Aerospace Education to Marine Biology, and a teaching background from Jr. High to College. He is a native of Montana, where he majored in Biology at Montana University, receiving his B.S. degree in 1957. After teaching in Montana Public Schools for two years, he received a National Science Foundation Grant and earned a Master's degree in Science Education from Pennsylvania State University. From 1960-63, he taught Biology and Marine Biology at Bowden College in Brunswick, Maine. His involvement in Aerospace Education began in 1963 with the Educational Programs Division of NASA. From 1963-69, he worked at NASA's Western Operations Office in Santa Monica, California and at the Ames Research Center in California. Mr. Bacon began his career with Civil Air Patrol USAF as Director of Aerospace Education, North Central Liaison Region, in 1969, where he served until he was named Director of Curriculum at CAP Headquarters in 1971. In March 1980, he became Chief, Aerospace Education and Assistant Director of Aerospace Education for CAP. On August 21, 1983, he assumed his present position as Deputy Chief of Staff, Aerospace Education, the top job in the CAP-USAF Aerospace Education Program.***

**MR. BACON:** Thank you, Dr. Duca.

It is nice to be back.

Our headquarters are in Montgomery, Alabama, at Civil Air Patrol Headquarters at Maxwell Air Force Base.

Civil Air Patrol has been involved in aerospace education for a long time. In fact, the definition that Civil Air Patrol has for aerospace education is the definition that was really established in 1948 by a young Air Force captain named Mervin K. Strickler. Many of you know Doc Strickler. Doc Strickler wrote as his thesis at Stanford University a definition of aerospace education. When he left the Air Force, and came to work as Civil Air Patrol's first Director of Aviation/ Education, he brought this definition that he had written in his dissertation with him. That definition has continued basically unchanged ever since 1950, so it has been almost 40 years that Civil Air Patrol has had the same definition, and for Ed Moran, I would like to read the definition, because there are some other organizations that are involved in aerospace education other than in the scientific and technical endeavor. Here's what Civil Air Patrol's definition of aerospace education is.

"That branch of general education which is concerned with communicating knowledge, skills and attitudes about aerospace, and the impact of air and space vehicles upon society."

You notice that in the definition that Civil Air Patrol has for aerospace education it doesn't talk anything about science and technology. It doesn't talk anything about preparing people to become pilots, or engineers, or flight attendants or any other endeavor.

What Civil Air Patrol is interested in, and because of the relationship between Civil Air Patrol and the Air Force, what the Air Force is interested in is an informed citizenry. You know, it's interesting, if we look throughout the United States, there are about 800,000 licensed pilots in this country; there are about 1,300,000 employees in the aerospace industry. There are approximately 10,000,000 people in this country that directly or indirectly are involved in aerospace-related endeavors, careers, work. Well, that means that there are about 230,000,000 of them out there that aren't, directly involved in aerospace and those are the ones that we're interested in impacting.

**Aerospace education is... That branch of general education which is concerned with communicating knowledge, skills and attitudes about aerospace, and the impact of air and space vehicles upon society."**

Now, certainly, by teaching aerospace in the classrooms, by providing an understanding and appreciation of aerospace in the minds of people, you certainly are improving their scientific and their technological literacies, because you can't teach aerospace without teaching it as either a scientific or a technical course. But general education is that branch of education that we believe everybody should be involved in. And when we talk about aerospace education as being a general education course, really what we're saying is that in order for this country to maintain itself in a position of leadership, in order for this country to maintain itself as the world's Number 1 nation in aerospace, we need a citizenry that understands and appreciates the importance of this thing that we call aerospace. And that's basically what we're involved in, and that's basically what we've been involved in ever since we've been in this game for almost 40 years.

Now, how do we do this? I think probably the greatest contribution that Civil Air Patrol has ever made to the education community in the United States is through our teacher workshop program. And I'm glad to see that we've got a couple of our people here that have taken workshops, that have become interested in aerospace through those workshops. And, we've even got one of our workshop directors who has taught these workshops for many years seated in the very back of the room.

Basically, what we're interested in is bringing teachers into a college and university setting, and giving them a very broad, general understanding of what aerospace, aviation and space is all about. So that they can then go back into their classrooms and begin to use these concepts to help teach reading and writing and arithmetic, and do it in a language that excites the kids.

**I think probably the greatest contribution that Civil Air Patrol has ever made to the education community in the United States is through our teacher workshop program.**

You know, all of us agree that flying is fun. For some reason there's something innate within every human being that excites them about being able to fly.

If we can utilize that interest, that innate interest that kids have in flight, to help teach, then we can do a much better job of it, and that's really what we're doing.

Since Civil Air Patrol had become involved in workshops since about 1952, we have conducted nearly 5,000 of these, and we've impacted nearly 150,000 teachers. We've got 150,000 teachers out there in the classrooms that are utilizing this to help teach young people what it's like to live in the world that they're going to be living in.

We continue to hold about 200 of these each summer at 130 or 140 colleges and universities throughout the country. So, one of the efforts that we have, and I think probably the greatest contribution that we've made, is in the field of teacher education.

The thing that's interesting is once the teacher goes back into her classroom, as Toni Brown can attest, she becomes a leader in aerospace within that school system, and becomes a teacher teaching teachers. That's exactly what she's going to be involved in in her school system in Wyoming, When those second-graders go into that third-grade classroom, as she mentioned earlier, that teacher suddenly is going to come right up against the fact, "Hey, I don't know too much about aerospace, Toni, teach me." She's going to be called upon by her school system to share this information and share this knowledge.

We're interested in teacher education, and we also have a continuing education involvement.

As many of you, most of you here know, NASA, FAA and Civil Air Patrol co-sponsor a national convention for aerospace education each year. It's called the National Congress on Aviation and Space Education. We've just completed the 21st Annual Congress in Los Angeles last month.

This is our continuing education effort, Once we get the teachers involved in aviation and space education, we feel an obligation to bring them back periodically, hopefully on an annual basis, and utilize that forum to bring them up to date on the new things that are going on in aerospace. And, to also allow them to share with their peers, with other teachers from throughout the country, the things that they're doing in their schools that are successful.

So the National Congress really has two basic purposes: One, to update the knowledge of the teachers through a series of speakers in a general assembly environment; and secondly, to allow the teachers with similar interests, either all the second-grade teachers getting together or all of the biology teachers getting together, and allow them to share techniques, activities, things that have worked in their classrooms. That teachers from Wyoming can learn things from teachers from New York.

**We're interested in sharing aerospace education with everyone**

The 1989 National Congress, the 22nd of these national congresses will be held in St. Louis next March 29th, 30th, and April 1st at the Clarion Hotel.

We're also deeply involved in Civil Air Patrol in preparing materials for teachers to use in their classrooms, and as Dr. Duca said, those materials are now going to be available in the Resource Center here at the U.S. Space Foundation, so that all of the teachers that come here that can have an opportunity to look at the types of materials that are basically developed by teachers for us.

We don't develop these materials sitting in our puzzle palace down at Maxwell. Those materials are developed by teachers that are out in the field teaching aerospace. They provide those to us, we publish them and make them available to other teachers, free of charge.

Again, we're not interested in duplication. We're interested in sharing aerospace education with everyone, and I applaud everyone that's up here, and I'm personally thrilled with all the new organizations that are coming aboard in aviation and space or aerospace education, because certainly the job is big enough for all of us, and again, I'm just awfully glad to be in Colorado Springs, Colorado.

Thank you very kindly.

**DR. DUCA:** Hal, do you still have your Civil Air Patrol teacher's directory with the workshops every year? I would suggest that if any of you would be interested in a Civil Air Patrol workshop, particularly if you're from out of Colorado, check with Hal for some of the outlying states.

Dr. Robert Brown is Director of the Educational Affairs for NASA. He will be our next panelist.

*DR. ROBERT BROWN is the NASA Director of Educational Affairs, Washington, D.C. Dr. Brown provides executive leadership and management of NASA Educational Programs including development and maintenance of effective working relationships with public and private educational communities. NASA projects such as Teachers in Space and Operation Lifeoff are designed to stimulate student interest in science, math and technology, with the goal of having a far-reaching effect on the nation's educational systems. Dr. Brown holds a B.A. degree in Sociology from Lincoln University; an M.S. in Psychiatric Social Work from Atlanta University and Ph.D. in Public Administration from the University of Southern California.*

**DR. BROWN:** Thank you, Dr. Duca.

I want to join several of my other colleagues on the panel here in expressing my compliments to the U.S. Space Foundation. This is my third symposium, and the Space Foundation really has proven itself to be an organization that has convening power; convening so many people with diverse interests and concerns. And throughout the session I've seen a value system that stresses the importance of education.

I do want to join my colleague, Wendell Butler, in his recommendation that next year the Education Symposium be placed in the center of the program week.

One other comment, if Dr. Duca would permit me. I do want to acknowledge the two people in the audience, Dr. Stephanie Wright in the back, who is one of the Teacher-in-Space ambassadors from Delaware and Dr. Gloria McMillan, here to my left, who is a Teacher-in-Space from San Diego California. Mr. Winstead referred to the fact that the Teacher-in-Space Education Foundation is now a part of the Challenger Center for Science Education, and I think that's a great match. But I call attention to these two fine Teacher as Space Ambassadors, as well as Toni Brown to my left. I do get concerned about our talking to the choir, but so often I run into teachers like the three of them who are so good at what they do; they're so enthusiastic about it, and it causes me to say, "Well, where is the beef?" And I know that there is a larger band of teachers out there that we want to reach with whatever products we have to offer, but I just felt a need to call attention to their presence here today.

I will try to be brief, and there are three areas that I would like to concentrate on. First, I would like to just give you a snapshot of our five-year educational affairs plan, which we were talking about last year when we were here and which now we have in place.

Secondly, I would like to share with you a few of the major NASA educational events that are coming up this year and next year.

And finally, I would like to mention some of the things that I worry about, some of which have already been referred to. I worry about them and I want you to worry about them. I think if we collectively worry about them, I think we'll find some solutions. One of my favorite philosophers is Sir Francis Bacon, who said that "If we will begin with certainty, we will certainly end with uncertainty; but if we will begin with questions, we're very likely to end with good answers" to those questions.

With respect to our five-year plan, we're real clear in NASA that we're not the Department of Education. We do have a statutory charge to make the products and results of the agency available to the education community, and we try to do this in a variety of ways in supporting programs K through graduate school. I may allude to some of those. But that is a charge that we have. We are not the Department of Education.

You may not know this, but just literally and physically, NASA is in the same building with the U.S. Department of Education. I have been on the job now going on three years, and it's no criticism of my predecessors, but the fact that we were physically in the same building did not bring about any sustaining colleagial relationships or joint activities. However, over the past year, Mrs. Dorsett and I, and members of my staff have had a number of occasions to get together and to discuss some of our common concerns, and her presence here today is a measure of our beginning to talk to each other. I think some good things are going to come out of that.

**There's good research evidence that tells us that if you do not capture a student's interest in science and in math in some meaningful way... the probability of their developing a deepening interest in science and math diminishes over time.**

In our five-year plan, we felt that we needed a road map to focus our resources. People think that NASA has a lot of money. Dr. Fletcher, meet with the Dean of Schools of Engineering in Puerto Rico a couple of weeks ago — and we prepared the paper for him. We received a lot of very important feedback from those deans and one of the things they felt was that Dr. Fletcher was being very honest and candid with them with respect to the budget problems that we face. The point was that many of those educators somehow felt that NASA gets what it wants. In fact, it isn't quite that way at all. We have to hustle and struggle and do all the sorts of things that other organizations must do. So in our five-year educational affairs plan we're trying to focus our efforts in order to use our resources in the best and most expedient way. There are five programmatic priorities of the plan that we shared with other members of the panel here, and with other organizations, because we want other organizations to join us in this initiative.

The first is **elementary education,** which has been talked about so much this morning. There's good research evidence that tells us that if you do not capture a student's interest in science and in math in some meaningful way — I'm not talking career decision, because kids don't make career decisions at that stage, the probability of their developing a deepening interest in science and math diminishes over time. So intervention at the elementary level is a very critical period, and we intend to devote a fair amount of our NASA educational activities to that particular segment of the education community.

The second priority is **teacher education.** We have not sufficiently tapped this area by working with deans of the schools of education and the faculty who do the methods of teaching. We intend to try to make some of our education resources more available to that community. This is a big country. We've got something in the way of 50 million students in schools at K through the university level. There are some three million teachers. While it's an attractive appeal to want to reach and touch and deal directly with students, that is not possible. The teacher is the critical leverage point, and we want to try to have some impact on them and we want to do so through the deans of schools of education.

The priority area that we stress in our five-year plan is **under-represented minorities.** That's already been alluded to today. Governor Romer referred to this in his remarks last night. We know what the demographic trends are telling us in terms of what the composition of this country is going to be in the year 2000 and beyond, representing at least one-third minorities, people of color, many of whom are not sufficiently involved in aerospace programming and education. We're going to have to use all of our resident talent in this country to maintain our leadership and our competitive edge. We will be missing a great opportunity if we do not address the under-represented minority portion of our population, and we intend to do that with respect to our NASA programs.

**We should be using high tech to deliver our services, and by example, encourage other parts of the education community to be more active with respect to educational technology.**

The fourth priority area of our five-year plan is **educational technology**. NASA is a high-tech agency, and we should be using high tech to deliver our services, and by example, encourage other parts of the education community to be more active with respect to educational technology.

Here, I refer to such technologies as satellite broadcasting and computer software, that stresses space science, in our aerospace education program. Many of our aerospace education specialists are beginning to use laser disks in their presentations.

Over the past year, we conducted four satellite broadcasts to educators around the country and we were down-linked to about 400 sites. The most recent one was on the launch vehicle preparation, and prior to that, space station. Both were interactive, where teachers and educators could call in and raise questions.

I would like to just ask the question, how many people in this room have participated in any of the video satellite broadcasts that we have conducted over the past six months? I ask people this because it tells us something about how large the universe is, and I will come back to that a little later on.

The fifth and final programmatic priority of our five-year plan, is **educational partnerships,** to which several of my colleagues here have alluded.

I don't feel threatened at all about the emerging educational organizations that are coming into being. I do think there must be some order. I think we have to think about sharing our resources. There needs to be some kind of coordination, but the demands out there and the need are so great that there is a place for all of these organizations. One of the roles that we see ourselves doing in NASA education is stimulating, using leverage and causing certain things to happen. And if other people are doing it, I say right on.

Now, turning to some of the major upcoming educational events that some of you may be or will be participating in, are as follows;.

One is a program, a pilot program which we call **NEWEST**. In NASA we are very well known for all of our acronyms. It's really a derivative of our older program called NEWMAST. The latter is a program for high school math and science teachers who spend two weeks working in one of our nine NASA field centers. They work with engineers and scientists and technicians, with the objective obtaining a kind of exposure and experience that they can take back to the classroom to enrich their teaching.

But these are high school teachers, and as a part of our five-year plan, we said, "Let's develop a NEWMAST type program for our elementary teachers." So we're going to have three pilot sessions in three of our NASA field centers this year. We're doing this under the auspices of the National Science Teachers Association. It is on the competitive basis. We expect to have about 90 elementary teachers in the program this year. If it goes well, we certainly will look forward to extending it.

A second area that is coming up this year is Naming the New Orbiter competition. Some of you may have seen this. We're working with the Council of Chief of State School Officers, and we are building an orbiter to replace the shuttle Challenger. It will be ready around 1991. We discovered during the terrible Challenger tragedy, that NASA doesn't own the space program. The people around this country own the space program, and they told us that in so many ways.

I wish you could see some of the thousands and thousands of letters that have come into our office expressing concern about getting the program back on track, and telling us over and over again, "don't stop". It seemed to us that one of the ways in which we could provide another opportunity for the citizens around this country and students to exercise that ownership of the space program would be to have an opportunity to name the new orbiter. It's intended to be an educational activity. It's not just a name, although we know sociologically that naming is a very important process in our culture. A name identifies events. Names causes people to galvanize around issues. Names make us and certain events unique. This designated labeling has great meaning, not just in our culture, but other cultures as well. The school systems and the classroom must research the basis for the name that they select, and they must develop some classroom activities around the particular project that they select. I won't go into more detail on that, suspect that project will fall on to even more fertile ground, because through Mr. Butler's office and the Young Astronaut Council, they have already distributed some educational materials around the whole concept of naming. I have a feeling that some of the schools with Young Astronaut Chapters are perhaps going to have a leg up on some of the others, but we'll see how that goes.

A third area coming up for this year is our second round of **satellite broadcasting** to reach educators. We are in the process of soliciting ideas from people on the kinds of things that they're most interested in that we would include those broadcasts.

Another area coming up, about which we just got some legislation is called the **Space Grant College and Fellowship Act**. We are required to define the nature of that program, which will include aerospace research, aerospace fellowships, and a public service component. Right now we're defining the nature of the program, and we consulting with a number of organizations around the country, and in particular at the higher education levels, to define what the nature of that program will be.

I just had a brief conversation with Tom, in the back there, who teaches at a junior college. That's another gap that we haven't paid much attention to the community colleges around the country as part of a feeder system. It may very well be that in our program definition for the Spacecraft Fellowship Act, we may be able to program the junior community colleges into that area.

Another area coming up, that as I really find very exciting, is our Long Duration Exposure Facility, labeled LDEF, which some of you may be a part of. You might recall that back in 1984 we launched a long-duration satellite that had 57 experiments on it, which we were supposed to bring back — in fact, the Challenger in '86 was supposed to bring back, and obviously that was not possible. We haven't known whether we would ever be able to bring the satellite back.

**We're just very excited about bringing those seeds back, along with the other 56 experiments.**

It has, from an educational point of view, 12 million Rutgers tomato seeds on it, and we had engaged a number of schools around the country. The objective, when those seeds are returned, is to take 50 of the seeds that had been in this extended microgravity environment, along with a control group of seeds, and have them planted, and try to determine differences and results in terms of germination rates, length of time, size of the fruit, chromosome structure, susceptibility to bacteria and fungi. Since one of the planets is acting up, up there, in terms of solar flares, the LDEF satellite is in a decaying orbit, and we've made a decision as an agency to return it. The schedule calls for July of next year, and we're just very excited about bringing those seeds back, along with the other 56 experiments.

It's another example of using the technology of the agency to stimulate interests in education, and for those of you who are skeptical about it, I would remind you that some of the seeds found in the Red Sea, which had been there for over 2,000 years, were planted and germinated.

A final area to mention in terms of upcoming events, is Dr. Fletcher's reference to the National Space Policy that the President issued. Within that space policy three specific areas are directed to education. We have not staffed them out yet, but one of them calls for what amounts to sabbaticals for federal scientists and engineers who are in the area of aerospace or space-related activities, who will take a one-year sabbatical to teach in the nation's school systems.

Secondly, I referred earlier to the NEWMAST program for high school science and math teachers. Our capacity has been around 200 teachers a year. We would like to do many more than that and National Space Policy calls for us to increase this by fivefold; and the '89 budget request of NASA includes funds to do that. We are hoping that we do get the '89 budget that the President has asked for.

A third component of that National Space Policy calls for NASA, NSF and DOD to develop educational materials and classroom activities and experiments, distribute them through the U.S. Department of Education to schools around the country to create "tech schools". We have not defined that as yet. I have had some discussion with Mrs. Dorsett, and you will be hearing more.

So those are some of the upcoming events in the NASA context.

Now, with respect to a few of the things that I worry about, I would like for you to worry with me. Gene Cernan, as well as the Governor, referred to this notion of "singing to the choir", and that we do that; we talk to people who are already convinced.

I don't demean that at all, because (Hal Bacon made the point very well), we get a sense of renewal when we come back and share ideas and we get a certain kind of updating and a type of reinforcement. But, we must go beyond the choir and reach out to the people around the country who are not converted as yet. We have to be more definitive and more convincing as to why we think what we're doing is important.

If you will permit me just one little anecdote about when I was on the faculty of the Federal Executive Institute... a program involving residential training for top-level executives in government. It was almost always a very positive experience for the executives after they went through this program for eight weeks. When they finished, the best description would be that they were euphoric. They were going to go back to their agencies to be change agents. But we learned from following up on them, that it's important to prepare for reentry. We would have sessions to prepare them to more effectively articulate to people who hadn't had their experience, what was so good about it, or what it meant to them. When you go out and say, "Hey, it was really great", that's fine. But you must be able to articulate that enthusiasm in some different kind of ways so that people understand specifically what we're about, and the why and the rationale for what we're trying to do. I think we need to give a little bit more attention to that.

**We have to be more definitive and more convincing as to why we think what we're doing is important.**

When we reach out to the extended concentric circle beyond the "choir" we need to anticipate new and difficult kinds of questions. For example, I was on the plane coming back from Los Angeles a couple of weeks ago. I had a very stimulating conversation with a ten-year-old, and when he found out I was from NASA, he just started to produce a barrage of questions. And what do you think were the three most difficult questions he asked me? He said, "What do you think about Big Foot?" Another was, "How much more have we found out about UFOs?" And the third was, "What do we know in NASA about the Bermuda Triangle?" I won't tell you my answers to those, but... I wasn't satisfied with my responses.

The other point that I worry about is this: I refer to the term as "constructive redundancy". This is a big country, with some 50 million students out there at the elementary level and high school level, in approximately 83,000 schools.

There's a certain amount of redundancy that is necessary to reach that total group. There's no one organization or person that can do it, and that's where I think our different organizations, as represented by this panel, come into being.

Two days ago I had to do a radio telephone interview with a station in Lima, Ohio. It was a half- hour show, and the moderator was quite assertive and who talked about the problems of education. She felt that the State of Ohio had been neglected in terms of aerospace education. However, I know that the State of Ohio, which is the location of of our Lewis NASA Research Center in Cleveland, was one of the most innovative aerospace educational directors in NASA's nine field centers. I know about some of the things that go on in the State of Ohio, because I've participated in them.

But the radio moderator said, "Well, we've never heard of those things. We're on the other side of Ohio and Cleveland is like another state." So here is the need for constructive redundancy.

**Hands-on teaching is based on the old adage that says, "I hear and I forget, I see and I remember, I do and I understand."**

Three weeks ago, I went to a press conference that when Al Shanker, the head of the AFT, made an announcement for a new approach in education. Some of his analyses were really disturbing. For example, he asserts that educational reform as we've come to know it is fine, so far as it goes, but the reform efforts taking place in this country really only affect about 20 percent of the students. The other 80 percent, according to Mr. Shanker, are not affected in effective ways. He's saying that the educational models that we have developed, call for consensus across the board, and in his view it is impossible to get concensus across the board: so you have to deal with little pockets of reform. Thus, Mr. Shanker is calling for a program that would create schools within schools, where consensus is more feasible.

Another area that worries me is that for the past five or six years, in education circles, we've talked so much about "hands-on", particularly in the area of the science education. Hands-on teaching is based on the old adage that says, "I hear and I forget, I see and I remember, I do and I understand." It's based on that concept. Yet some of the research is telling us that the amount of hands-on teaching has been seriously declining over the past decade in the country. Why is that? On the one hand we have learning theory that we have some confidence in and which we believe works, but our behavior is not consistent with what we say we believe. That worries me.

There are some other things but let me conclude by going back to the university level again. I'm concerned about teachers, and from what I see and read and hear form people that I talk to, teacher education at the university level is in a crisis in this country, a real crisis.

The president of Harvard University recently, when talking to his board about Harvard's School of Education, said, "Teacher training programs are relegated to the margins of the university, fighting for their existence, at a time when they should occupy center stage in the nation's efforts to improve our public schools."

**I think we all have an obligation to use the tools of our organizations that are available to us to help enhance the quality of education in this country.**

The Dean of Education at the School of Education at Berkeley, said, "I know what the problem is in teacher education." He said, "Teacher education institutions suffer from congenital deprivation. We don't, accord much respect to our teachers in this country, and it comes up in so many different ways, and yet we are expecting so much of them." Somehow or another we're going to have to address that. I worry a great deal about that public attitude.

We in NASA are not the U.S. Department of Education and you're not the Department of Education. But I think we all have an obligation to use the tools of our organizations that are available to us to help enhance the quality of education in this country. I think that's our charge.

Thank you.

**DR. DUCA:** Bob, thank you for your comments and for giving us something to worry about.

Our closing panelist, Dr. John Akey, has been with the Foundation as Teacher on Special Assignment for about a year and a half. His position has been funded by Southern Colorado School Districts, and John is literally responsible for building the Teacher Resource Center from the ground up. John.

*DR. JOHN AKEY was selected by several Southern Colorado School Superintendents to serve as the Educational Consultant for the NASA Space Education resource Center. Prior to this, he served as the Science Consultant to the Colorado Department of Education. Dr. Akey has over 30 years teaching experience in science and mathematics, pioneered integrated curriculum development and has published numerous articles. Dr. Akey is a past President of the National Science Teachers Association, has served on numerous national advisory boards and committees, and administers several projects funded by the National Science Foundation. He is a nationally and internationally recognized educator who has received the National Science Teachers Association's "Citation for Distinguished Service to Science Education" and the "Presidential Award for Excellence in Science and Mathematics Teaching - Colorado".*

**DR. AKEY:** Thank you, Tory.

One of the advantages of being last is to be able to evaluate what you've learned, so we're going to take a little truth test.

How many of you remember the first space event?

Over 30 years ago we got into the space business with Sputnik, and the second big space event was 19 years ago this July, and all of you better remember that.

**There isn't a single topic more exciting to kids, kindergarten through 12, than space.**

But we have to keep that in perspective, because there isn't a single student in our school system today that remembers either event, and that's very, very important when we take a look at it.

The theme of this forum is "Utilizing the Excitement of Space to Promote Quality Education." There isn't a single topic more exciting to kids, kindergarten through 12, than space. Now, if you're talking Kindergarten through Grade 3, you're going to get competition from whales and dinosaurs. But space is #1, and space is something that we should be using to promote quality education.

Presently, we're into a two-week project at Elizabeth Elementary School, where they're using space all day long, for every subject; and the kids, Kindergarten through Grade 6, will only experience space-related activities for the next two weeks.

You can use space to promote reading, writing, arithmetic and science. We shouldn't just look at space as a tool to promote only the math and science curricula, because it can get kids interested in art and in other areas of the curriculum.

We have to look very carefully at what's happening in education, and how we can use space to promote the quality of education. If we were to take a look at a few cliches that we kick around in education all the time, one of those cliches is that every time America gets in trouble, just "return to the basics." We call it the circadian effect in education, because it comes back to haunt us every 22 years. It's almost as if reading, writing and arithmetic will take over, and everything will be hunky-dory.

That's not really true, particularly in this day of, as Ed was saying, space illiteracy, and technological illiteracy. And so science and math and the other fields are just as important as reading, writing, arithmetic.

If we were to look at another cliche, "If it's good enough for me, it's good enough for my kids." Is that really a true cliche in education today? We'll take a look at that one.

**Between 80 and 90 percent of the jobs these students face when they go out into the world of work are not even on the drawing board in 1988.**

Another one that was a favorite of my mathematics teachers way down in the grades - "if 25 homework problems are good enough; let's give them 40." And research is telling us that that's no longer a valid statement.

And the last we've kicked around in science for years and years is, "Let's wait until the next century." It's almost as if by some magic on December 31st, 1999, we are in trouble; we wake up the next morning and everything is roses.

And so the world is changing, and we are just one school cycle away from that next century. The kindergarten students, this school year are the graduating class of the year 2000. What kind of a world are they going to face? To start with, between 80 and 90 percent of the jobs these students face when they go out into the world of work are not even on the drawing board in 1988. If we were to look at some of the things that will happen in their life, they will probably retire somewhere in the year 2050. What are we doing in the school systems to prepare those students to meet the professional needs that they have through the year 2050? About the only thing that we can do, instead of looking 62 years ahead into the future, let's look 62 years back into the past, and go back to 1926.

If you wanted to fly an airplane, you went out in a cow pasture, crawled in the back seat of a biplane, and you paid five dollars for five minutes. Your pilot was probably Hal Bacon.

The radio was something that was a family activity, and you sat around Sunday nights and listened to it. Today we have television; we're moving towards video telephones, so that you can actually see who you're talking to.

If you wanted refrigeration in your home, you waited until every second day when the ice man came by, bought a block of ice and put it in your ice box.

**A student who graduates in the year 2000 will sit down and put his report or his master's thesis or his dissertation into a computer vocally.**

We didn't have microwaves. We can go on and on. But the big thing is that the past 62 years will not, in any way, compare to what's going to happen in our world in the next 62 years.

So, let's take a look at the cliche that, "If it's good enough for me, it's good enough for my kids." Is it really true to say that parents of our Kindergarten students today, who probably graduated from high school in the years between 1970 and 1975 had an education that will be adequate for their children, who are going to go into the new world in the 21st century?

For instance, technology is upon us. If we were to look at something as simple as spelling in our school curricula, we still have textbooks that have 30 words. We give them to the kids on Monday, pretest them on Wednesday, and they take a final test on Friday, so they can forget them for the next set of words on Monday. All of this in a world where today we have word-processors and typewriters that will give us 300,000 words stored in memory. Certainly that's got to have some impact on the way that we are delivering a spelling curriculum to kids.

If we were to look at the writing program, as a result of space technology, we now have a voice-actuated computer, which also is used to manipulate wheelchairs.

But today we can use the voice-actuated computer for word processing. A student who graduates in the year 2000 will sit down and put his report or his master's thesis or his dissertation into a computer vocally. They won't pick up a ball-point pen or a pencil until after they have developed a draft. They will pull out the hard copy, sit down with their paper and pencil, clean it up, rearrange the paragraphs and make changes in the structure. It will totally change the way that we write reports and papers.

Yet we continue to stress the concept of writing in the curriculum. I'm not saying writing and spelling and mathematics are something that we leave out of the curriculum, but certainly, technology is going to have a big impact on how we deliver the curriculum.

Looking at mathematics, the State of Wisconsin and all of England have already eliminated long division from the curriculum. There is no advantage whatsoever to being able to sit down and do 40 homework problems where you divide five digits into seven digits. The only advantage is to the paper, pencil, and ball-point pen companies.

The next thing that will go from our curriculum, undoubtedly, is going to be long multiplication. Of what value is there in going through this drill and practice process, when today between 70 and 75 percent of the K-6 curriculum can be done on a five dollar calculator? Fifteen years ago, calculators ran $100. How many of you have five calculators in your home? You fill up your tank of gas or buy a bag of groceries, and you get a calculator. The calculator has to be incorporated into the classroom and the math people know how they want to incorporate the calculator into their program. The long division is coming out, they want to put in a K-12 articulated geometry program.

**Of what value is there in going through this drill and practice process, when today between 70 and 75 percent of the K-6 curriculum can be done on a five dollar calculator?**

Let's look at the field of science for just a minute. Seventy-five percent of what we know today we've learned in the last 20 years. If you turn that around in the perspective of 1967 and look ahead for the next 20 years, that would represent a growth of 300 percent, which is an average of about 15 percent per year.

When Megatrends came on the market in 1982, it made a prediction that by 1985 the doubling rate of knowledge in our country would be about 35 percent. That's based on the fact that knowledge would increase every two years.

Toward the end of that 20 year period of time the growth knowledge was at the 35 percent level, so that would indicate that back in the late '60s our growth knowledge had to be much less to average 15 percent for the entire 20 years.

If we were to look at the prediction for 1985, Megatrends was very close to being on target. If we further look at Megatrends and almost read between the lines, it indicates that by the time our kindergarten kids are all the way up to Grade 3, which will be in the year 1990, the doubling rate of knowledge in our country will be every 39 weeks, three-fourths of a year; and if you plug that into the magic formula of dividing the rate of change into 70 to get the doubling rate, that will give you a growth rate somewhere in the neighborhood of 100 percent per year.

What does that mean for 1990? It means that when the teachers come to school, in August of 1990 to check out their textbooks, and they come back in August of 1991 to check out their new textbooks, if the textbook has not doubled in size, the textbook is losing ground.

Some of the predictions for the year 2000, when our kindergarten students graduate from high school, suggest that knowledge will double every ten days to two weeks, which represents a growth of about 2,000 percent per year.

**We need to teach kids how to process information, how to ask questions, how to apply information from one setting to another setting.**

Now I ask you, is the education that is good enough for me good enough for my kids? And I think the answer is no. We can use that excitement in space to get these kids to be better students, to not remember facts and not be content oriented in a world where the most popular game on the market is "Trivial Pursuit." How does Trivial Pursuit maintain a financial impact - by adding decks of cards? And they're adding the decks of cards faster than the kids can memorize the facts.

We must shift to a retrieval system. We need to teach kids how to process information, how to ask questions, how to apply information from one setting to another setting. Probably the most critical item that a teacher will face in the next 15 years is what to leave out of the curriculum, because there's going to be too much to leave everything in the curriculum. We're going to have to capitalize on the exciting things, such as dinosaurs, whales and space and aviation, and some of the things that really motivate kids to be good learners.

So at the Space Foundation, we really believe that we can use aviation and space education to promote the quality of education in all areas. We invite you to come out to the Space Foundation, and we will be glad to visit with you about our programs.

Thank you very much.

**DR. DUCA:** I would like to take a moment please, to acknowledge and welcome Dr. Bill Wallisch, who is a special Consultant on Education to FAA Administrator, Mr. McArter.

Thank you for coming.

After lunch, we will reconvene here, and we will hear Mr. Robert Stack, who is the State Ambassador/Space Ambassador for Colorado Springs, and also Dr. Eleanor Wynne.

Thank you.

# UTILIZING SPACE EDUCATION IN THE CLASSROOM

**Bob Stack,** Space Ambassador - Colorado
Department of Education

**DR. AKEY:** Bob Stack is a science teacher in Greeley Public Schools, north of Denver, and for the past year, he's the Science Consultant for the Colorado Department of Education. In that role he has an opportunity to travel all over the State of Colorado and some of the United States talking to teachers, talking to kids, doing workshops not only in the field of science, but in space education.

It is our pleasure, Robert to have you back.

*ROBERT STACK was born in Cambridge, England and grew up in Maryland. He received his B.S. degree in Zoology, his minor in botany and chemistry and M.A. in Elementary Education. He spent four years with the Institute of Arctic Alpine Research. Commissioned as an officer in the Air Force, he served on active duty for six years, including Viet Nam. While stationed at Vandenburg Air Force Base, his office did the explosive safety studies for the Space Shuttle in 1970. He now resides in Greeley, Colorado. Robert Stack was nominated by parents as Teacher of the Year. As Space Ambassador, he represents Colorado in the Teacher-in-Space Program. This past year, he's been on loan to the State Department of Education as Science Consultant and will continue in that capacity next year.*

**MR. STACK:** Good afternoon, and thank you for taking the time to be here. Some of you are administrators, some of you are military, and some fit into other areas, but your efforts all blend together, when you have involvement with students. Whether you have your own or are somehow associated, your efforts should blend right with them.

I was trying to figure out how to start this off. My initial reaction was to come in and say, "Damn it, let's get something going!" But I've got a new job this year, and I'm on loan to the State Department, so I have to be somewhat tactful. I found that I would say, having listened to a couple of the speakers earlier, that there really are things out there happening. There's interest and excitement out there happening. And it needs to be nurtured. It needs support. And when we're looking at superintendents and principals and school boards, folks that you interact with, whether you live in this state or not, that's crucial.

**The last thing a teacher needs right now is to be told we've got something else to put into your day.**

Four things today. One the importance of getting comfortable; two the resources that are available; three, "you," and four, activities that are inter-disciplinary. The last thing a teacher needs right now is to be told we've got something else to put into your day.

Let me look at "comfortable" first.

One of the — and I will borrow this from John Akey and the U.S. Space Foundation — things that they talk about in the program they offer during the summer is called "Getting Comfortable Teaching With Space." As I travel around the state, my concern is getting teachers comfortable teaching science. I have met people this year who teach science and hate it. Why? They don't have a background in it, that was not their forte. A teacher might say, "I can do the best IRI, informal reading inventory, in my district but the science person has left, and I was just told yesterday that I have got to teach science. I could care less. We'll fit it in Friday afternoon, just before we go home." And that happens, and that's not to blame the teachers, and that's not to blame the school districts. They use what resources they have available.

But the issue is getting those teachers comfortable, and that's what they'll say. I ask "What does it take to have you teach science?" The reply is, "I need to understand it, and I need to feel okay about it."

There are a lot of things available: resources — which I'll talk about in a few minutes — another is finances, and that's a big push-button with everybody right now.

**The training that those teachers would receive, could come right back, be put into that classroom, and fire up those kids.**

In the position I hold, I monitor the Title II Economic Securities Act Federal Funds. What that means, in nuts and bolts, or I should say dollars and cents, is that each school district is allocated so much money for math and science education. It could be used doing in-services, or it could be used for manipulatives. It could also be used for teachers that you want to beef up a bit in the area of science and especially space education, because to me those two are synonymous. For example, If a school district submitted its application this August or September and said it wanted to send so many folks to the Space Foundation or it want to put so many folks through the FAA course, I would definitely look favorably on that. The training that those teachers would receive, could come right back be put into that classroom and fire up those kids. The teachers need to fire themselves up first, and that's where your help comes into play.

Second item, "resources." I know money is short, and everyone's saying how can we do more with less? We've been doing that for a number of years, and it looks like we're going to be doing that for a number more. That situation has no political ties, the money pot is only so big.

There are materials available, and that is the best part. The materials right now are in the form of slides, they're in handouts, they're in booklets, they're in video cassettes, films, interactive teleconferences. Gloria McMillan sitting over here has done a lot last year and this year with putting your kid in touch with someone in the Space Program; maybe it was Gene Cernan or Harrison Schmidtt. The students can get on the phone at their school and talk to someone who's been there in space or on the moon. That fires the interest! That keeps the teacher excited and the classroom excited.

**DR. BALDAUF:** Did you say that's already paid for or there's no cost for that?

**DR. MC MILLAN:** No cost.

**MR. STACK:** Part of the resource there is, and this ties in with alliances that are popping up around the country, that you've got the educational system working with private enterprise. There are other locations where you have the educational system working with the military, working with private enterprise, working with community, and it all ties together. They're all our kids.

You also have organizations with their own programs, some that were represented this morning, Young Astronauts, Challenger Foundation, U.S. Space Foundation right here in our own backyard, FAA, and the Civil Air Patrol. They're funded, albeit somewhat limited, but they can get you materials and they can get you help.

**Things change, and you have to step through those bureaucratic doors and shake some bushes.**

Turning to the third item: "you." I guess these comments are directed towards administrators and superintendents, but I think they fit everyone. You're the models for the students. You do the leading. You have charge of what happens in that building or that community. "You" supports! Those are very critical "yous". I know sometimes we sit there and say, "I'm one voice, what can I do?" I used to sit up in Greeley, and say, "Gee I've got all this energy and ideas, I'm one voice, what can I do?"

Things change, and you have to step through those bureaucratic doors and shake some bushes. Sometimes they're big bushes, sometimes they're little ones, but "you" is a very key element, and I know that's not grammatically correct, but it fits.

Part of that "you" needs to take care of what I would call, business and the military call it O&M, operations and maintenance. "You" must build this in if your program is to succeed. "You" need to do more for that teacher than just say, "Here's the latest textbook or here's the neatest hands-on kit, now go for it." There needs to be follow-up! To give a specific example, I met with the staff of a private school in a community nearby. I talked to a fifth-grade teacher who had gotten the Berkeley lung unit. In this unit you go through the entire respiratory system and the kids come out of that unit knowing more than most adults in this country. It has a lot of hands-on centers. At one point you even dissect beef lungs, and you've got students with scalpels going to town and they're excellent. I know, you smile, it's hard to believe, but they take on a very professional atmosphere when they are allowed to do that activity! It's active learning.

Back to my example, the teacher was given the equipment and the material, and that was it. She didn't have an in-service, there was no follow-on. Now all that material sits on the shelf in her room, and she's gone back to her book and opened up to Page 78 look at two or three pages on the respiratory system. So the O&M in science isn't just let's pay attention to it this year, forget it, and then seven years later we'll recycle back and look at our science curriculum. It can't be that way anymore. It's changing too quickly, and you need to support those teachers.

The fourth area, "activities being interdisciplinary". Some of the things I want to show you are learning devices and they're toys, because you've got to have fun with them. These are things that people have shared, and you end up sharing with others.

Let's look at one. Being a teacher, plain economics, you look for in expensive things like going to Safeway and getting meat trays and asking them, "Listen, we're going to build flyers. Can you give me a couple hundred trays?"

You take that meat tray, you put a little pattern on it, you cut out some pieces, and you come up with a little flyer. (items are held up for audience to see.)

You then do a little sanding, and again, it's experimentation. You've got kids all over the room, they're not locked into a seat. They're teaming. And that's another thing that has to happen, cooperative efforts, and they try their different ideas on each other. Now, I've played with this one, and with me it works pretty well with a large paperclip. I've got the top of the leading edge sanded and the top of the trailing edge sanded. I didn't invent this, a fellow named Norm Hoff from NASA showed this to me a couple of years ago in a classroom. You can now take it and work with other folks. It pays big dividends. I have done this with kindergarten, first and second-graders. They've got some manipulative skills, and they can take a pencil and crease through the styrofoam.

## The little kids were talking about aerodynamics

You don't just say here, make this and do the hands-on. There is the thinking that goes along with it and the talking about the molecules in the air. We talked about Monty and Martha Molecule to try to work the learning at their level, and what happens as the flyer passes through the airstream. The young children left that afternoon when mom and dad came over were very excited. The little kids were talking about aerodynamics, and what did that really mean? That meant there's some little molecules that go across the top, and some little things that you can't see see, that go underneath and the ones on the top have to run across faster, and that allows the bottom ones to push up.

You work at their level. You can also work it at high school level and everybody in between.

You don't have to throw the devil at it out of it, it just takes a little finesse. (Flyer is flown into the audience.) Nice catch!

The activity then takes off into doing a double decker wing. That takes off into sharing between these two people, who say well, what about this idea and that idea, and you are into brain-storming.

It's cheap, it's inexpensive, you can get a lot out of it and you get in some really good teaching. Yes, little kids can play with the ideas of physics. Little kids can play with chemistry. You work it at their level.

Not too long ago I was at what I would call a lock-in school. You walk into the school; well, you don't walk into it, the administrator unlocks the door, you go in, and he locks it back behind you. He unlocks another one, you go down the hallway, and there are different fist sizes that have been punched in the door to let you know the students have been there. He unlocks the classroom and you go in with the students. We did some space activities with the students.

This kind of thing got them excited, and if you can get through to those hard-core folks and show them some real learning and some hands-on, son of a gun, all of a sudden, lots of these kids who have been abused, don't trust anybody, are working together. You've made some real breakthroughs.

Some other things: (holding up straws) you take a straw, McDonald's is great, they've got a better sized straw than Burger King — not advocating anything there — a one-hole paper punch, and punch holes in straws and hook them together. You're looking for something to catch the interest and develop, and again I'm still talking inter-disciplinary. Now you've got something like this (holding up a straw structure).

You take some toothpicks and you put it together, and you've got a — this is Bob Stack's version — space station. But it doesn't end there, because as I tell the students, anybody can punch holes in straws and stick them together. So after you do that, you take a look at what you've got. What does this module represent and now draw a cutaway of it, and maybe you want to team up with someone else. What happens in each of these sectors? Now they're not hollow straws anymore, they're places where work is done, where people live and create.

Okay. You've done some hands-on. You've got some art coming in, and mow some critical thinking, because you can't just stick things in a room anywhere, especially if you're playing with "up there". You also slide in math because you've got to have a sense of dimension, and sizes: what fits and what doesn't.

Then you present (public speaking) to your class or to others what happens at your station. All of a sudden what was just a nice cutsie little thing has become very involved. This has worked, with students in elementary right on through college.

It's neat to see high school students start tinkering with the space stations. One group — and the project was designed originally for individuals to work independently and create their own — one group ended up linking theirs together. We had a six-foot space station hanging from the ceiling — I think ceilings are one of the most under-used pieces of equipment on our planet. They had combined their efforts: the Japanese portion was here, the Syrian portion was there, the United States module was here, ESA was there, Russia, China, etc.

They started talking about, what are they viewing from space. Where and when do they want to rotate the station so they can see each of their countries. Cooperative efforts really came out with a project like this using some basic ideas, some playing and experimenting.

## The NASA satellite programs, not only give you the data of the space station or space telescope, but then serve as an in-service to teachers.

Another item is this inter-disciplinary booklet, a teacher's guide, that NASA sent that out in preparation for the Challenger launch. There are ideas in here for using music, art, math, science, literature, with space in your classroom. And it's just a seed, it's a starter. It shows how you can build your own orbiter — and some of us did. We had the kids measuring out the floor, putting the tape down, — drives custodians up the wall — recycling cardboard, designing the interior, seeing what fits and what doesn't, teaming and creating all of a sudden the classroom has become dynamic and real.

Anything is open and available to create with your space station. NASA still isn't quite sure what they want to do with theirs. I tell the kids, "Hey, it's open to you. You do some creating. Send your ideas in, maybe they'll buy off on what you came up with."

I mentioned earlier the satellite interactive programs. NASA has gotten into that area this year. There are some other agencies around the country doing that also. Ms. McMillan with the San Diego School District has started some dynamic things and fired up a lot of people. The NASA satellite programs, not only give you the data of the space station or space telescope, but then serve as an in-service to teachers. They give you some ideas of what to take back into the classroom. These ideas need to be relevant, they need to be things that people can latch onto, not only the kids, but you and I. For example, the space telescope it's built, sitting in moth balls, and it's the size of the Greyhound bus! I'm not good with measurements — 100 feet by 25 feet I have trouble imaging that, but you tell me a bus, and that hits home. Tell me the power of an SRB or the size of the orbiter, but give me something I can relate to.

There was talk during lunch about the need for a goal, and I fully agree with that. We haven't had a goal for a long time. We need something that we can grow and live with like Apollo, as you and I did.

I would look at "Mars" right now, because as we work in our schools, that is something your students will live to see. They will continue to grow with a Mars project. Now, it comes in stages, this will come with the orbiters getting back up there. It's going to come with the aerospace plane, it's going to come with space station, it's going to come with the lunar colony, but it's all directed toward a goal — Mars.

I would like to see us take that as a national, and definitely as an educational goal. To blend things in, and that's the key, to be inter- disciplinary, to being able to show teachers now to integrate, because I know they have no room to add anything else. They've already done AIDS, they've done drugs this year, alcohol, they're trying to fit all of that in, and there isn't much room to cram into that six or seven-hour day.

A couple of parting items; whether you're an administrator with the school district or an active community member, maybe a quiet community member, or a parent, you're the one right now with the visions, you're the one that is in the power seat.

**as an educator, it makes no difference to me whether you're military or private business or in the academic world, you're going to use my product, and if I put out a quality product, that benefits your organization.**

The students out there, and I would differ with the good congressman in this area, have shown an incredible amount of interest around our country and I know around our state. I have seen a lot of Young Astronauts programs spring up this year, and a lot of people saying, "What can we do to find out more about space?" That needs to be nurtured.

We have gone dormant but the students haven't, and we need to get fired back up again. You need to act, and whether it's little bushes or the big ones, you need to shake them. You are a key player.

Governor Romer and the new Commissioner of Education are very dedicated, and seem to be putting their money where their mouth is on education in the state. They are wanting good things to happen. In Fort Collins this morning the Commissioner was saying that in five years he would like to see Colorado with the finest educational program in the country.

One of the things that can help, I firmly believe, is playing to the Space Program, to space education, getting people excited, because with that excitement you can accomplish. The shuttle or the space station is a vehicle to put in capitalization, punctuation, 8 times 7, social studies, and others. It all fits, and that has to happen a lot more actively than what we've been doing.

I guess I would say as an educator, it makes no difference to me whether you're military or private business or in the academic world, you're going to use my product, and if I put out a quality product, that benefits your organization. If I don't put out a good product, that also effects your organization. So you see, you've got to be involved in that education! One of the firestones right now is capitalizing on space. That's the kids' future, whether they go out there or not, that's going to be part of their lives every day.

I would like to thank you again very much for being here and taking your time. A young lady once said, "I touch the future, I teach." and that was Christa McAuliffe. She does and we all do, and the doors that we've already opened, we can't go back and close. Those kids are our future, our lives, and our future depends on them.

Thank you very much.

# THE FUTURE BELONGS TO WHO "KNOWS TO KNOW"

**Dr. Eleanor Wynne,** Professor - University of California-Irvine, CAP Educational Advisory Committee

**DR. AKEY:** Our last formal presentation this afternoon is by Dr. Eleanor Wynne. Dr. Wynne is a very dynamic person. I met her for the first time today. We've had several conversations on the phone and we kicked around several titles for her presentation this afternoon. They were really unique, but we zeroed in on the one that you see in the program, and I think it's really a very clever way to wrap up the day. Those who need to know will know.

Dr. Wynne is a professor at the University of California in Irvine, and also is a very active member of the CAP Educational Advisory Committee. Dr. Wynne, we look forward to your closing comments this afternoon.

**DR. WYNNE:** Thank you, John, and good afternoon, ladies and gentlemen.

I really want to thank the U.S. Space Foundation for inviting me to be a presenter this afternoon, and particularly to be your wrap-up speaker.

In being a final Friday afternoon speaker, I knew I would be guaranteed of two things: One, I would be guaranteed to have a small audience, which lends some intimacy to our group; but even more important, I knew I would be guaranteed an audience of people who really care. We would have an audience of those people who are facing the Space Challenge of 1988 and intend to do something about it.

So, I thank you too for being here.

Someone had said to me, the very best thing to do is tell some jokes and sit down. I would love to do that, and if you want to hear some jokes, we can meet together later when we are all sitting down. Our time is too valuable for that.

I want to share some other kind of information with you, but first, I want to tell you how much in awe and humbled I am to participate in such a symposium.

When you really think about it and look over your program and note the brilliance in the audience and in the presenters, you will note that it's really very, very impressive.

**Where else and at what other time have you been so exposed to so much mental giftedness and the people who convey it in such a hospitable manner?**

If you judge that the gifted and talented in education have a mental capacity or an IQ of approximately 130 to 135, please note that we have been surrounded by that for three days. Simple mathematics tells me — because of small purses now, I do not carry a small calculator in my purse and I have to resort to using my mind — but with my simple mathematics, in estimating that there were about 70 presenters, we have had a cumulative IQ of about 10,000. That's a lot of IQ with which to be surrounded.

Add to that your lunch and dinner partners, the folks sitting next to you, all high achievers, and, of course, each one of you, and we have a cumulative IQ of about 130 million.

Now, MENSA should take note. Where else and at what other time have you been so exposed to so much mental giftedness and the people who convey it in such a hospitable manner?

If anyone asks, the U.S. Space Foundation is really where it's at, they are doing it!

**Teachers are miraculous people who are saving kids every single day.**

I apologize to you because I don't have a message of "doom and gloom" for you today. First of all, I'm not a doom-and-gloom person. Otherwise I would be in a dark black dress. I really am a very positive person, but more than that, because I'm a grandmother, I really recognize the brilliance of children. Anyone that's a parent or a grandparent knows that our own children are brilliant, and you only need to talk to another parent or grandparent and find that their children are brilliant, so, in the United States, we have millions of brilliant children.

You only need to talk to some teachers and find out that education is in good order. Teachers are miraculous people who are saving kids every single day.

Perhaps we do need help, perhaps we do need more money, perhaps we do have some days when we're fatigued and overworked and wonder what our days are going to bring to us. But the same time, we see some student who has finally arrived at knowing a concept that we've been working on for days and days — and thought he would never get — and then he does.

We have that parent who calls and tells us, "Thank you for helping my child learn something." We have those experiences where we leave at the end of a school day and we feel that we've done something really worthwhile.

As administrators, there are many things we would like to change, particularly school board meetings. But you go out and you see the students on the playground, and they come up and show you some of the things they've done at school and you feel education is in good order.

You look with awe at some of the youngsters who participate in the Rockwell Science Laboratory Program, where they spend their summers during high school, at the Rockwell Plant in California. Because they're so accelerated in science, Rockwell says come and work with us.

**But they cannot overcome what they don't know because they don't know what they don't know it, and so they remain not knowing."**

We look at the students who are entering the engineering programs and how accelerated they are in learning, so our students are in good order and our schools are in good order, even though we have some other things that we want to work on.

Recently a chief executive officer of a major corporation was put in charge of the future development of his corporation, and in an interview he was asked this question: What is the biggest worry that you have in your job? His answer was rather startling, and I'm going to read it to you, because it's a tongue-twister. He replied, "I worry most about what my people don't know that they don't know. What they do know that they don't know they are able to work on and learn, but they cannot overcome what they don't know because they don't know what they don't know it, and so they remain not knowing."

Now, this is more important than just a play on words in that we know that a newborn infant moves from not knowing that he doesn't even know, but he knows that he wants to know. The newborn tries to learn everything and he begins learning.

In psychobiology we are researching how the brain really works. What motivates the infant to learn? What motivates the toddler to learn? And when we look at infants and toddlers, we recognize that they learn at a higher stage of processing and at a faster pace than any of us learn at any other time in our life.

What motivates the preschool child to begin almost every sentence with "why." They want answers. When we give them answers they ask another "why," but they also remember the information that we've given them.

When is it that we begin to lose that knowing that we want to know? And as we process through school, why do we lose that ability to go on wanting to know just to know? Some people never lose that, and what we see in our correlative studies is the people with the higher IQs have, one, a higher energy level, and second, they retain the interest in wanting to know what they don't know.

**...but I heard words like ferroelectronics, FRAM, Digital memory defractor, words that our students will not even find in their current dictionaries.**

What we're trying to study is what separates those people from other people, so that we can help everyone retain that energy level and go on wanting to know what it is that they don't know.

Our neurobiologists are reaching for, researching for this information, and it's from the technological developments in our country that we're able to do more brain studies and see what takes place in the brain when someone is actually learning or participating in a mental exercise.

We know that our future really belongs to those who know to know, and it is because of that that you are here this afternoon.

Paul Valery, in his work on "Managing for the Future," which is a business text, tells us, "The trouble with our times is that the future is just not what it used to be," and we could convert that to a more layman terminology by just saying the future sure "ain't" what it used to be, but we have to adjust to it.

Certainly this theme has been well documented at this Symposium.

We must even respect that the vocabulary is changing. I sat in a meeting yesterday morning where I was wondering what the speaker was talking about. I was so short of vocabulary — and I'm a talker, so I have been working on vocabulary development for years — but I heard words like ferroelectronics, FRAM, Digital memory defractor, words that our students will not even find in their current dictionaries.

I was recently in a Los Angeles school and trying to do some work with the teachers there in helping them have access to space education materials, and talking with some of the students there. When I get in to a classroom I immediately move to sit with the children and work from that level, because it's so exciting to do that. One of the children asked me, "What is an astronaut?" And I said, "Don't you know what an astronaut is?" They said, "Yes, it's somebody that travels in space, but where did the word come from?" I was a little stumped. So I said, "Let's look it up in the dictionary."

We went to the dictionary to look up the word "astronaut". The dictionary in that room for the children to use was so old that the word "astronaut" was not in the dictionary.

Some of us can even remember the word "mouse", as a reason that you stood on a chair.

We've changed the use of words like this. Now "mouse" has several meanings, and we're even talking about the "genetic" mouse.

We can recall General Brandt's theme yesterday morning, in which he said, "In today already walks tomorrow," and our children and youth are walking that pathway.

We have no choice but to invest in the future of America, and in investing in the future of America, we must invest in the children and youth and the families of our country; and in the fast-paced, high-speed, information-based society, we have to figure out how are we going to keep up. We're all busy. We all have demands. We all have stresses, and the world keeps asking more and more from each of us.

A suggestion I have for you is to think in terms of a positive approach and expanding our horizons.

Restructuring has long been a favorite word among educators, particularly those who are now concentrating on the technology and education.

But the history of American education and the use of new technology effectively gives reason for some skepticism about the aspects of change in our educational system.

**The teacher should be a well-prepared person who is helping the children learn the technological advantages.**

We seem to be changing in our world faster outside of the schools than inside of the schools.

Or perhaps our students are doing the restructuring in our schools, rather than the people, as educators, inside our schools doing the restructuring in our schools. Are we doing it from the outside in or from the inside out? And if it is indeed from the "outside in", what is happening from the "inside out" that our students are having to effectively change our schools, so that those of us in our schools are the ones who are being re-educated, and having to restructure?

I felt I solved the technological problem, through no business of my own, by just having the grandchildren, because my grandchildren are going to take care of me in the technological world.

But the thing that I find is that often the children are in the classrooms teaching the teacher about technological advantages, and we have to change that. The teacher should be a well-prepared person who is helping the children learn the technological advantages.

The Carnegie Task Force on Teaching has recommended vast expansion in the use of instructional technology in our schools.

**Education is the foremost method that society uses to prepare for the future.**

That report tells us that the schools will have to produce workers who can function in a high-tech society; if our nation is to compete effectively in a highly competitive world market. We must have high-tech education for living in a high-tech society.

Education is the foremost method that society uses to prepare for the future.

Where are we now in preparing for the future that our kids are already living in? Computers and other communication technologies will have the most profound impact on our educational changes, but we must not use the Chinese dinner approach, in which we order a little of everything and hope that we have something there that will satisfy the appetite of everyone. We must plan for and implement the educational change.

California has recently defined: by July 1st of 1988 every teacher, in order to get a credential, must either pass a computer competency examination or take a computer competency course, in that we now respect that it is so essential that our teachers be prepared in the technological world, so that they will be leaders in the classroom, rather than leaving it up to the children to be teaching the teachers. And what we're asking is that the teachers be prepared in the following four areas: They must be prepared in computer-based technology. Those are technologies based on the computer, such as telecommunications, interactive video, and compact disks.

The second area, they must know are system components, hardware such as printers, monitors, modems, disk drives and other peripherals that work together in a system.

They must be prepared in telecommunication, the use of computers, modems and telephone lines to move information and data over extended distances, and they must be prepared in networking, the terminals or computers linked for the purpose of moving information from one place to another.

It is expected that they will also be covering the moral, legal and ethical implications of the technological world, and to look at the economic and social implications of the technological world. They will be looking at how to use the technological systems for teaching, how to help the other children develop the technological systems for their learning, but also something that we all look forward to is how to utilize the technological system to make our time and energies more efficiently used.

The microcomputer is very small and cheap now, and what we're seeing is that it is in the financial and convenient reach of almost every household.

**What we're seeing is that now we will probably have computers in every household.**

It wasn't too many years ago that we looked at TV as a major method of education in the United States. In fact, the Children's Theater Workshop bargained to get all of the money out of the Headstart program and put all of that money into Children's Theater Workshop. Congress at that time reported "We don't know that we could do that, because we do not have a guarantee that every family has a television."

So these people who wanted this money did some research, and they gave us the information that almost every household in the United States has a TV. Do you know that even in the Appalachian Mountains, where they do not have electricity for lights and refrigeration and so forth, they had a generator plugged in to run a TV?

What we're seeing is that now we will probably have computers in every household.

Kindergarten children are arriving at school computer-wise. Almost all schools have computer availability in their classrooms. We are now seeing that children may be building their own computers in school.

And while we're talking about building gliders for our art activities, imagine how fascinating it will be to have a group of fifth-graders building a computer.

With also this mass market, we see the mass production of quality software, and it's being every day stimulated. Software can provide immediate and current information at a much faster pace than most textbooks.

Computers will become simpler to use and yet become more powerful. Light pens and mouses will replace the keyboard except where we need the word processing.

The major breakthrough will be the perfection of computers that will respond to voice commands, and for a talker as I am, I will have a very, very busy computer. These voice-command computers are already in the development stage but are primarily being used by the handicapped individuals in our society. Anybody will be able to talk to the computer without weeks of training in computer language or skill in typing.

Now, this is really user friendly, because that computer always gives you a very polite message if something is wrong, and that's better than we get from some human beings.

**The art of being an educator is to know what learners know and to teach people how to learn. To give learners information that they need to know.**

Future computers may be able to create knowledge and to learn from their own mistakes and to correct mistakes. Another trait that is not always possible with human beings. When we look at the learning process of children, one of the essential ingredients that we see is that we replace inappropriate information with appropriate information.

The educator's role is not a clerical role, to find what children do wrong or what it is that children do not know. It does not take a college education to find out what someone doesn't know. I have total strangers and neighbors that know what it is I can do wrong and what it is I don't know.

The art of being an educator is to know what learners know and to teach people how to learn. To give learners information that they need to know.

Computers will do this for us and in a friendly fashion.

An inventor, Ray Kurzwell, has developed a very interesting computer that imitates a symphony orchestra of sixty different instruments and a choir. When a note is struck on the music synthesizer, it intelligently recreates the sound of any of the parts of the orchestra and blends these together. What a nice way to be a musician.

Kurzwell is one of our many pioneer inventors who is applying his research in artificial intelligence, or AI, as it is known, and that is where they're teaching computers that can learn and think much as human beings do, and in some cases perhaps a little better than our human beings do.

In the process, we're constantly learning more about the way human beings learn, because as we study artificial intelligence, we are programming how the human being learns into an artificial system, and the interesting aspect of that is that we cannot design the artificial system without studying the natural system. That way we're learning the way the brain functions, which is really the very essence of our educational research.

**Technology will continue to be the driving force for change in our future.**

For example, programmers who design computerized educational games must study how children think, how they organize and process information, how they draw inferences, how they test by hypotheses, and how they use knowledge. In order to sell these games, they need to know how children are going to use them. Our neurosurgeons and neuro-researchers are using computers to study how the brain works, which has led to many possibilities in the treatment of brain damage and head trauma. Technology will continue to be the driving force for change in our future.

The almost overwhelming growth of computer-related technologies, such as robots, will continue unabated. Virtually all areas of life will be changed. Work, home and entertainment, values, and relationships will change.

Perhaps even in the study of computer interfacing we will learn more about how human beings interface with other human beings.

Something that we're looking at now, in studying the IQ of individuals, is not just how much information they retain, but what their interfacing is with other human beings.

**75 percent of U.S. business and 60 percent of U.S. homes with computers will have modems by 1990, allowing them to link their computers to the world's telecommunication system.**

As more and more jobs are automated, the role of the worker will undergo enormous change. Computers will be partners with us in our work jobs. Robots will assist us in jobs ranging from auto assembly to brain surgery. Computers will free workers from dangerous or monotonous tasks and enable them to tackle more interesting jobs.

It is estimated that more than 75 percent of U.S. business and 60 percent of U.S. homes with computers will have modems by 1990, allowing them to link their computers to the world's telecommunication system.

Computers will give us access to all of the card catalogs of all of the world's libraries. Eventually, individual books may be called up on a student's terminal at home from even distant libraries, and then they can program in the information they actually want to have access to.

I was very excited to hear that the U.S. Space Foundation is going to be working on curriculum that could be in published texts having to do with aviation and space education, but I'm also very aware that perhaps textbook publishing is becoming obsolete in our country. It takes four to six years for a textbook to be published. In our rapid-paced informational society, by the time a textbook is published in four to six years, we have moved at thrice to four times that speed down the road and the textbook, before it's published, is obsolete. We may have to look to technology as a faster way to provide current information in our educational systems.

**This telecommunications technology, which replaces paper with electrons, has the amazing capacity for carrying thousands of messages swiftly over vast distances.**

Another major technology already having a spectacular impact on education is the union of laser and fiberoptics. This telecommunications technology, which replaces paper with electrons, has the amazing capacity for carrying thousands of messages swiftly over vast distances.

It is revolutionizing communication, which is the heart of the process of education. It may make the dream of universal education around the world a reality.

We may develop a universal language for technological transmission of information very much as we have developed an international sign to convey messages around the world.

We may develop a universal technological communication system so that we can better communicate with each other, but for all that is going so well, perhaps there are, indeed, some cautions.

Seymour Papert has predicted that the new educational technologies will enable us to modify our learning environments to the point that schools, as we know them today, will have no place in our future.

Now this could be troublesome to some parents who really want their children to be out of the house. We know that by the end of August parents are waiting for schools to open. If we come to the end of August and the schools don't open, what are we going to do with all of these children?

But it is an open question, will the children adapt themselves into forming a new system of getting together? I doubt that schools will ever really disappear, because anyone who has ever had teenaged children know the only reason they go to school is to see their friends, so they are going to continue to meet with their friends, and hopefully we will be giving them something else to do at the same time.

**The new educational technologies will enable us to modify our learning environments to the point that schools, as we know them today, will have no place in our future.**

Kindergarten children would not be able to exist without "Show and Tell", and so our elementary kids will also be in a "togetherness" so they can jump rope, shoot marbles and play dodge ball with their friends.

To address a question that came out this morning, David Elkins, in his most recent book, **Miseducation,** warns us that we may indeed be overprogramming our youth and children. After all, we have to look to the reasonableness of play, and the importance of play in learning, and the importance of learning social interactions before we become a computer wizard.

Aldous Huxley cautions us that an entire generation will grow up without knowing how to work and without any work to do, as automation takes over more and more roles, and Erickson, the psychiatrist, has told us that one of the problems that we're having with children is that we have not allowed them to participate through that period of the Sense of Industry, which is about the ages of seven, eight and nine; a period in which children love to work. And believe me, you to have capture all the work that you want them to do for the next ten years when they're seven, eight and nine, because after that they're increasingly mobile and they get away from you.

But one of the value structures that we know children have and that they need to retain is the value of the responsibility of knowing how to work and understanding the quality of doing a good job. Is William Bennett right when he cautions us that the speed of technology and the dissemination of information creates such an unhealthy competitiveness in our children and youth that they do not have the time for nor the opportunity to learn value structure and human relations.

Are we getting confused in our roles? Is the robot becoming more human and the human becoming more of the robot?

Many of us who work with children on a daily basis are very concerned about what is happening with our children.

With the Back to Basics movement, the computer Scantron test, the filling in of one answer to a set of questions we know that we are not teaching critical thinking skills, we are not teaching language, we are not teaching written expression, we are not teaching decision-making, and we are not teaching creativity or even promoting creativity.

**Will we have that creativity, the critical thinking skills, the imagination, the intellectual vitality to go on at such a rapid pace in a technological society?**

What we are doing is, perhaps, turning a group of human beings into the robots; they are taught to give one answer, get it down, even if it's on a scan test, and turn it in, and you are evaluated as to whether you're a good person or not based on a score. And I ask you, is this right to do to the human being? We have robots that can fly our airplanes, but it gives us a very precarious feeling if we don't see a pilot get on.

So, the human being has some importance. If the robot is now designed under artificial intelligence to do more than the human being, who is going to take over the design of the robots in the next generations? Will we have that creativity, the critical thinking skills, the imagination, the intellectual vitality to go on at such a rapid pace in a technological society? And finally, does the mass media technology hold the danger of a greater centralization of power over information that is communicated?

George Orwell's classic book **1984** does suggest this danger. Such power in the hands of corporations has important economic implications, and in the hands of government, important political consequences, which could be hazardous to the welfare of the free people. And what are the ethical and moral values here? What are we thinking of? What are the implications?

We, as a free nation, do not like censorship, but who is really going to be looking at the information that is conveyed in a technological system where we often have parents who are too busy to monitor what it is their children are learning from a computerized system or from their video system.

Who is going to be looking at the conveyance of that information and how is it going to determine what the implications are in our international world.

Perhaps as educators we need to be proactive, rather than reactive and create a new educational context and by that means find and put into place new solutions.

We must consider our children and youth as our greatest national resources and develop that potential accordingly.

I respect what has been said today about teacher preparation institutions. If you are not in higher education, preparing the cream of the crop to be your educational leaders of tomorrow, and preparing them in a current technological way to convey this information in a very humanistic fashion, who will be our educators of tomorrow?

I know the hour is getting late and people have planes to catch, but this has been a very exciting time to be with you.

**We must consider our children and youth as our greatest national resources and develop that potential accordingly.**

In closing I ask you to please "know to know" because knowing to know keeps you excited about learning. When you're excited about learning; your students are excited about learning. Accept the Challenge of Space 1988 and let's get going with it. The future is in your hands, in your hearts and in your heads. But perhaps even more important the future of our children and youth is also in your hands, your heart, and your heads. And the future of our country is in your heart, your hands, and your heads.

May you have a very safe journey home and a very invigorating and exciting future.

Thank you.

**DR. AKEY:** Thank you, Eleanor. I'm one who now "knows to know" where the title came from.

The interesting thing about the conference, as Eleanor said, we had a lot of intelligent people making presentations. I just hope some of this IQ rubs off.

There's a lot of information available and it's very important to interact with people, as we've had an opportunity to do today. If we were to look to the future let's use a Chinese proverb of about 2,400 years ago:

If your plan is for one year, plant rice, for ten years, plant trees, for a hundred years, educate men.

The key people at this conference are those of you that are sitting in the audience, because you are the people on the cutting edge, working with the students in the trenches, promoting this kind of enthusiasm. And the kids are terribly, terribly excited about space.

On Wednesday we had between 1500 and 1,600 students go through the exhibits, an hour through the exhibits, followed by 30 minutes in the theater with an opportunity just to see and talk with an astronaut.

It wasn't what the astronaut was saying; it was the opportunity to see the astronaut, and see somebody that has flown in space.

And so our challenge of educating America's youth is really a very important role, and we must meet that challenge.

I want to close out the session with some cross-talks, and some questions and answers. Phil Woodruff and Bob Brown from the panel this morning are still in the room; Bob Stack and Eleanor are still with us. Let's get some interaction from you.

Do you have any questions, comments, closing remarks or that you would like to make before we wrap up this Second Annual Educators' Forum? Any questions or comments? I can't believe that we don't have a few comments from this group. You're either very well educated or very tired.

**MS. TONI C. BROWN:** We're just trying to decide what we need to know that we don't know!

**MR. AKEY:** Eleanor will address that.

**In fact as adults, we can only learn what our bodies will allow us to sit through.**

**DR. WYNNE:** Could I make one comment? Because this was a thought I had in walking back from lunch with a delightful teacher. She was talking about the hands-on activities that she does in her classroom, and we were discussing workbooks, and ditto sheets and so forth; and being very involved in learning theory, something that I've studied is children do not necessarily learn from worksheets and ditto sheets and so forth, because our learning therapists really tell us that children learn at a time when they are least expecting to incorporate the information. They do not learn when you are presenting concepts to them, because they are too busy trying to incorporate what you are telling them.

The same is true with adults. In fact as adults, we can only learn what our bodies will allow us to sit through. We must give children more than that. When we are looking at worksheets and ditto sheets, we have to remember that currently they are being used as an evaluative tool, not as practice for children to incorporate concepts. And perhaps we have moved into having children be too quickly evaluated on information that they have not been allowed to cognitively process, so we need to take a look — learning is a series of practices.

If you learn to ski, you do not go to the fastest ski run and jump off of it, and have someone tell you whether or not you failed. If we taught skiing the way we teach reading, we would have even more orthopedic surgeons.

We look at these tools as a way that children reinforce, practice what they're doing, and then we evaluate them in a different way; but when we use practice as evaluation, we have perhaps mistaken what we're doing with that opportunity to practice.

And the last thing I will say to you, because it did not fit anywhere in with what I was saying, is I've often said to parents — because I do a lot of parent counseling. Children can't take all learning home in their hands. Parents want these worksheets coming home so they can look at scores. I tell them, if you want the kids to come home with something in their hands rather than something in their heads, that's a very easy clerical task; but what we're looking for is kids to come home with things in their heads, because they then can do them with their hands.

**DR. BROWN:** One of the things I was interested to hear this morning is our U.S. education comparison with the Japanese. That comes up so often in our circles. I'm not an expert in that area, but I do know that one of the differences is that Japan has a very small land mass, which is not sufficient to produce the kind of economic development that they desire. They know that they must rely on their resources **in the person,** culturally as well as economically. That is one of the reasons why they invest so much in education, because it's **human capital**. They don't have the land mass.

There are other things about the Japanese culture that may not comform with our American values. Are we prepared to extend to the number of days in school as the Japanese? Are we prepared to have our kids go to school on Saturdays? Are we prepared to have mothers buy textbooks for themselves along with their children so that they can study with them? Are we prepared to have mothers go to class when their children are ill? These are some of the very profound differences in out cultures, and I think we need to be careful when we're thinking about adopting the Japanese model.

**That is one of the reasons why they invest so much in education, because it's human capital. They don't have the land mass.**

Now I'll jump to the other end of that caution and say that we shouldn't just put the Japanese model away and say that it's just not compatible at all with our culture. I'm reminded of Woodrow Wilson who said that we learned to accept rice from China; but we didn't accept the chopsticks. The moral here is that we can look at other cultures, and other systems and distill that which is applicable to our own circumstances. That's the message.

**DR. AKEY:** Thank you, Bob.

I want to thank the speakers that participated in this education forum. One of the advantages of being the host organization is that you get the last word.

We would like to invite you to come to United States Space Foundation. We have a number of things that are available As an FAA/CAP/NASA Resource Teaching Center, we're committed to collecting the materials which are going to be beneficial to you as you work with the students.

We have four computer menus available. One is a menu of video tapes. We have over 150 video tapes that are there for the using. If you provide a set of blank cassettes, we'll copy them free. We'll even pay the postage to return them.

We have 18 public domain Apple compatible floppy disks from FAA and NASA that again are available on the same basis; you provide us with a clean disk, we'll copy it.

We have between 85 and 95 publications which are free for the taking. We will have three separate workshops this summer — "Getting Comfortable Teaching With Space." The three workshops are to get teachers comfortable teaching with space, not only to provide them some ideas with how to teach space, but to give them some of the content and understanding of how the space program really works.

Along with the graduate credit, which is available for the course, we ask teachers to develop two lesson plans. These lesson plans are placed into a computer database. The computer database will then be available to all teachers. At the present time, we have about 45 lesson plans in the computer.

We have over 400 lesson plans to enter into the computer bank. The purpose is to develop a system that will disseminate these materials.

At this conference, we've announced the development of SPACENET. Aviation and space information that's available at the resource center can be retrieved via modems. It is now available to the teachers in the Sidney, Nebraska area by dialing directly into the system. All of this was made possible by a grant from John Egging, The Egging Company of Sidney, Nebraska. I am going to ask Mary Ellen Dube', who is the Assistant Director of Education at the Space Foundation, to talk a little bit about SPACENET, so that you too can take advantage of these materials.

We're still working out the bugs. But certainly by the time that school starts in the fall, it will be a free-flowing system that will be very valuable to educators.

Mary Ellen.

**MS. DUBE':** I would like to thank Dr. Eleanor Wynne, first. I thoroughly enjoyed that talk. We may be a small group, but I think we're a very fortunate group to be able to hear such thought-provoking ideas.

SPACENET. We're putting all the information that John mentioned into a computer. You will be able to retrieve this information through a modem.

At this point we're doing the pilot with Sidney, so the menu isn't fully developed, but it will be soon. We will have electronic mail, computer conferencing, retrieval of all the information we just talked about; you can order videos through the modem, and hopefully we will develop a base of space experts. If there are any volunteers that would like to help with that on-line, we would love to have you.

We will have kids be able to call up and ask a question, and have a volunteer on-line send the answer back to them.

**UNIDENTIFIED SPEAKER:** What systems is it compatible with, IBM, Apple?

**MS. DUBE':** The floppy disks or the system itself?

**UNIDENTIFIED SPEAKER:** Is this just a hookup to your computer or to a voice computer?

**MS. DUBE':** A computer hookup.

**UNIDENTIFIED SPEAKER:** Which systems, IBM compatible or Apple?

**MS. DUBE':** It's compatible with any computer that has a modem.

**MS. TONI C. BROWN:** Through your modem, from whatever they're using to whatever you're using, the modem switches it.

**MS. DUBE':** It's on a Xenix software, so the software is in our system in the Space Foundation. When you call up on your computer, your computer becomes a dumb terminal; it doesn't matter what it is. And then it reads our software, and you're working with our software; you have a file in our file space.

Teachers eligible to use the system will have a special log on. When you call up the number, you can leave a piece of electronic mail, tell us that you're a teacher, and we will send you back an ID number.

Any other questions?

**UNIDENTIFIED SPEAKER:** Is there a cost for this or is it free?

**MS. DUBE':** That has yet to be determined. There is no direct cost for the materials. We'll be up 24 hours a day to keep telephone charges as low as possible, and we'll look at other ways to help with that.

**MS. TONI C. BROWN:** In Wyoming, our university has a teacher center, and they have a modem and a little net in the state. Can they hook into that, and then actually transfer from that?

**MS. DUBE':** Yes, and ultimately and I do think that we probably will see a lot of that. NASA, Dr. Brown was telling me, has quite an extensive network, and I think we eventually need to get out to these networks that are there and somehow link them all together and use it that way.

**UNIDENTIFIED SPEAKER:** I got the impression when you call now, if it's not up it doesn't work?

**MS. DUBE':** No, it's up in its pilot stages, but the menus are not fully developed, so if you do call in, you'll see a screen. If you were at the presentation on Wednesday, you saw exactly what you would see on your computer. You call that number you log in as guest, g-u-e-s-t, and you will see, "Welcome to the United States Space Foundation SPACENET," and it will have a series of menus. We call it Pikes Peak Launching Pad, and you can go in to look around the system, as you would physically look around a building and see what you like. Teachers will be permitted, with an ID number, to go into the system to a point, and then there's a gateway. If you're a teacher, or you get an ID number or for whatever reason as a volunteer for example, then you can get further into the system. It's like getting by that first door.

**DR. MC MILLAN:**. Do you have any brochures or articles that we can use to do any press releases on it.

**MS. DUBE':** We do have a press release on it, and we certainly would be happy to provide that on-line. I can send it too.

You will be able to pull up the press release on-line by going in as "guest" and going into the press releases confidence, but I can get you one. Any other questions? Thank you very much.

**DR. AKEY:** Thank you, Mary Ellen.

I want to close by introducing three other staff members. We have two people that we couldn't do without in the Education Resource Center — Mike Bashonski, and Sean Clark. They're two students from Sierra High School here in Colorado Springs, and over the last year and a half, these two young men each have donated well over a thousand hours of volunteer time to the Space Foundation.

Another person that made this conference possible is sitting in the audience. I want to express my thanks to Chuck Zimkas, the Director of Operations at the Foundation.

Thank you very much. Keep up the good work. We'll see you next year at the third educators forum and the Fifth National Space Symposium. Thank you.

# FORUM LUNCHEON

Moderator:
**Dick MacLeod,** Executive Director,
U.S. Space Foundation
Speaker:
The Honorable **Joel Hefley**
Congressman, Colorado

**MR. MACLEOD**: Good afternoon, ladies and gentlemen. I am Dick MacLeod, the Executive Director of the Space Foundation.

I know we have quite a disparate group here today and it's kind of an experiment. We had two differing forums going on this morning. First, the Space and Aviation Education Forum, bringing in some of the key leaders in aerospace education and keynoted by Ms. Beryl Dorsett, the assistant secretary of education for elementary and secondary education.

We also have the Space Law and Policy Forum being conducted in another location with a tremendous group of speakers, some coming quite a distance, from Canada, France, and other places, to participate. I'm particularly pleased in that regard, and I say this with deference to the fact that most of the speakers are of the type that in any other gathering would be introduced one by one. I would like to give the prize for the longest distance traveled to Mr. Pierre Bescond from SPOT Image. We're delighted to have you all here.

We've had a third forum that was not on the program, in which we gathered together some of the key executives both in and out of government for a discussion on what is happening and not happening in space today. This seemed to go reasonably well. Helping out quite a bit with that was Dr. Edward Teller, who is seated right below us here.

I'm delighted to see that, gauged by the noise of the conversations, that all this intermixing seems to have gone very well.

At this point I would like to introduce a gentleman who is a first-term Congressman representing Colorado in the Colorado Springs area particularly. He has come up through the Republican party in the State of Colorado and has been so successful in a very short time that he was elected president of the freshman class, that is, of the new members of Congress this year. Without further comment, I would like to introduce the Honorable Joel Hefley.

**CONGRESSMAN HEFLEY**: Thank you. Thank you very much, Dick. What a wonderful thing this is that you have put together, and I apologize for not being able to be with you for all of it. I was just involved in a tremendous session this morning and it was exciting to be there. It's presumptuous for me to get up and say anything about space with a group like this, with great educators, great legal minds, great scientific and engineering minds. It's presumptuous for me to discuss it at all.

*JOEL HEFLEY is a U.S. Representative of the 5th Congressional District for the State of Colorado. He serves as a member of the Science, Space & Technology Committee, and on the Subcommittees of Natural Resources, Agriculture Research & Environment, Space Science & Applications. Hefley also serves as a member of the Small Business Committee and on the Subcommittee of SBA & the General Economy. Hefley has previously held the office of State Senator of Colorado and State Representative of Colorado. Hefley worked for the Community Planning & Research Council as Executive Director (1966-1986).*

I should have been here at the beginning of the week to welcome you to the Fifth District of Colorado which I'm fortunate enough to represent, and to the Broadmoor Hotel, which is one of the finest places you can stay in America. I hope you have had a chance to enjoy it.

I learned a great deal this morning from being here with you and I appreciate that. I learned one thing particularly, and that was never to be the only Congressman in a group like this because I got all the barbs and the frustrations that you have about Congress. People would talk about that rotten self-serving Congress who doesn't have the vision to see what we need with space programs and they would always cast a look down at me when they said that.

I just want to hasten to emphasize what Dick said in the introduction, that I haven't been there very long.

I was fortunate enough as a freshman to get to be on the Science, Space, and Technology Committee and to be on the space subcommittee. It has been a tremendous learning experience for me and I have really enjoyed that kind of opportunity.

Another reason that I probably shouldn't have come here today is that as we were coming into lunch, Dick MacLeod says, "Oh, and by the way, Joel, Senator Garn is not here and he was going to be our luncheon speaker. Would you fill in for him?"

Well, I just wonder if this is a little like Abraham Lincoln when he was riding the train up to Gettysburg and someone walked down the aisle and said, "Oh, by the way, Abe, would you make a speech while you are up there?" You've heard the stories, which I understand aren't true and probably are just legend, that he wrote the Gettysburg Address on the back of an envelope and that that envelope has great historical significance now.

**Let me just tell you briefly that the committee I serve on is solidly behind most of the things that I heard you pushing for this morning. We have a strong desire to get things moving again in the space arena.**

Well, when Dick told me I was going to fill in for Senator Garn, this is my envelope, and if any of you think I will ever be famous, you might want to collect this. I think there's little chance of that.

Let me just tell you briefly that the committee I serve on is solidly behind most of the things that I heard you pushing for this morning. We have a strong desire to get things moving again in the space arena. The sense I have is that there's a predominance of thought there that we have dropped the ball with space.

We were the pre-eminent space program in the world, there was no question about that. We had a goal that really caught the imagination of the American people when we had the Apollo program and President Kennedy stood up and said, "We are going to put a man on the moon in this decade." And, you know, there wasn't too much concern about what section of the country got the pork out of this project; that most of it was going to Houston or was going to the Cape. There wasn't a lot of concern about that because we had an overwhelming goal to put a man on the moon in this decade. Once that great achievement was done and we were riding the crest of the wave, we dropped the ball. Not that the space program hasn't gone on, not that we haven't had tremendous successes, not that it hasn't gone well in many, many respects and, in spite of the fact that the Soviets are ahead of us in space exploration in some categories, our technology probably far surpasses theirs in most ways. None the less we dropped the ball in terms of the imagination of the American public.

I think there is a predominant feeling in the committee that we made a terrible mistake to put all of our eggs in the shuttle basket. I know some of the reasoning behind that. It was an expensive program. In order to sell the idea of the shuttle we had to say the shuttle will do it all and we know now that the shuttle won't do it all. We will have been without access to space in a practical sense for about two and a half years by the time we fly again. If there is any good that can come out of a horrible tragedy such as that, maybe that good is that it's opened our eyes and made us realize we need multiple ways to have access to space, and so we are building the expendable lift capability again. Fortunately, we did not shut that down completely and get completely out of that business. I think this is a good and a very positive kind of thing.

**What we need, now, in the space program is a something that will catch the imagination of the American public again. Maybe it's getting the shuttle flying again, although that's probably not enough**

What we need, now, in the space program is a something that will catch the imagination of the American public again. Maybe it's getting the shuttle flying again, although that's probably not enough; maybe it's the Space Station. Although, as I sit in those committees and I listen to the testimony about the Space Station believing deeply that we need to move on with the Space Station, there are still many unanswered questions in the minds of even committee members about its importance.

What will the Space Station do? Just what does this mean?

**But the House of Representatives as a whole is not solid on space. I think they're not solid on space because the public is not solid.**

So I doubt that it is enough to catch the imagination. Maybe it's a moon base, maybe it's Mars exploration. Whatever it is, we need to catch the imagination.

As I said, the committee is solid. Let's move ahead with dispatch. But the House of Representatives as a whole is not solid on space. I think they're not solid on space because the public is not solid.

We have heard a lot of statistics this morning about how polls show that the public supports space by a figure of about 80 percent. Boy, I'd be excited as a candidate if I got that 80 percent figure in my polls. I wonder if that's not an intellectual support. If I ask you on a poll, "Do you believe in motherhood?" at least 80 percent of you would say you do.

So there is a difference between an intellectual acceptance of, "yes, we support the space program," and an emotional acceptance that, "yes, this is something that we are excited about and we want to support." I don't know how you measure that in a poll but I think that's the key to whether or not the American public really gets behind this which in turn is the key to whether or not the Congress of the United States really gets behind it. It needs to be an emotional kind of commitment.

**I've talked to people in practically every hamlet and fire station across the Fifth District of Colorado, and the subject of space, if I don't bring it up, never comes up.**

Until a few weeks ago I was involved in a political race with a fellow who is a great advocate of the space program. He talked about the space program in his campaign speeches a great deal. Yet I have held more town meetings in the year and three months that I have been in Congress than any Congressman in the history of this state and perhaps any Congressman in the history of Congress, although that's a broad statement, so I'm not sure.

I've talked to people in practically every hamlet and fire station across the Fifth District of Colorado, and the subject of space, if I don't bring it up, never comes up. There is an emotional commitment to social security and, there's an emotional commitment to balancing the budget and the line-item veto. People are very emotional about whether or not we ought to support the Contras and about military COLA's. But there is no emotional commitment, it appears, to space.

In fact, the Congress, until a year ago, had the Science, Space, and Technology Committee as a secondary committee. They moved it up this last year but prior to that it wasn't important enough to be one of their Class A committees.

We don't need an academic acceptance on the part of the public about space, but we do need an emotional acceptance. We need people taking pride again in our space program and saying "that's our program and we are excited about it." Let me use an analogy.

I have two daughters at the University of Oklahoma, and I had the opportunity to be down there on Dad's Weekend one fall and watched the University of Oklahoma play football. If you have not been in Owens Stadium at the University of Oklahoma that is an experience you ought to treat yourself to sometime. You don't sit down during the game. They won by 74 to 3, that day. But if you are an Oklahoma fan, that wasn't enough. The enthusiasm and the excitement that was generated during that game was unbelievable. I had not been there in many, many years and it was unbelievable.

**We really don't have a goal for space. We don't even have a goal for defense, and that's why we argue so much about SDI and those kind of things. If we had a goal to defend the nation, then SDI would be a foregone conclusion, I think, in most people's minds. But we really don't have.**

I had the opportunity to attend a game at CU the next week. A little different. The stands were not full, the people were having a great time. They had their shirts off and they were passing bodies up and down the stadium, and when the game was over, they probably had to ask their neighbor, "What was the score?" The difference was that at OU there was an emotional commitment to this program and at CU everybody who went to the football game thought it was just kind of fun.

We need that kind of emotional commitment to space. The problem is that our successes in space have been quieter after the Apollo program and our failures have been very public. Although we haven't had a lot of failures, they have been very, very public.

We really don't have a goal for space. We don't even have a goal for defense, and that's why we argue so much about SDI and those kind of things. If we had a goal to defend the nation, then SDI would be a foregone conclusion, I think, in most people's minds. But we really don't have.

When you have a chairman of a committee, a subcommittee of the Armed Services Committee, saying that the best defense for America is no defense at all, we don't have a consistent goal to defend the country.

Well, we don't have a consistent goal in space either. We had some talk this morning about competing for resources. How can we get our space program not to have to compete with some of these more emotional things. The answer is you do have to compete. And, we have to have enough commitment from the American public that we can win that competition.

Every time something like this comes up, they say, "Oh, gosh, but we've got so many homeless." Yes, we've got homeless. We are putting billions of dollars into trying to deal with that problem. We're not ignoring that problem. And there are going to be homeless from now on. We're not going to ever solve it completely. We need to work at it. But we are going to have to compete for resources.

**So instead of rushing into space again, we are waddling a little like a duck, with multiple goals, multiple voices, multiple focus. We need a focus. We need a coordination. We need some way of pulling together the many viewpoints that we heard this morning into a specific direction**

If we have the Supercollider, we probably won't have the Space Station at the same time. It's those kind of tradeoffs that we have to make.

So instead of rushing into space again, we are waddling a little like a duck, with multiple goals, multiple voices, multiple focus. We need a focus. We need a coordination. We need some way of pulling together the many viewpoints that we heard this morning into a specific direction so that we have our focus on what we really do want in space. We need the legal, the educational, the military, NASA, the civilian, and the commercial aspects all pulled together into some kind of an organization for space. Maybe the Space Foundation is the way to do that. You have certainly done a great job with this Symposium and maybe that's where the focal point ought to be to pull these different thoughts together so that we can come up with a plan that gives us a focus and gets us excited and gives us that emotional commitment, too.

So I would hope, Dick, that we would leave here today committed to establishing those goals. Definable goals! And that we make a commitment. That's a little harder than just goal-setting. We must make a commitment to accomplishing those goals.

And then the third step. It's easy to set goals. You sometimes can even be committed to those goals. But we must also leave here today with determination. That this is something which absolutely has to be done and we're willing to sacrifice a few personal interests, to see that it does get done.

We hear a lot about making America pre-eminent in space again. We need desperately to do that because the cost of not doing it is too high a cost for us to pay.

Thank you very much for letting me come.

**MR. MAC LEOD**: How's that for a pinch-hitter?

Senator Garn called last night and said he had just been asked to go out to the White House this morning and discuss his specific actions on the Toshiba controversy and that was why in fact he's not here with us today. I doubt that he could have said any more clearly what the Congressman has said here this morning.

It did remind me of a little story of a hen and a pig walking down the street through a small village, and they observed that there was one family, a very skinny family, very obviously undernourished, underfed, and the pig turned to the hen and said, "You know, we've got to express some commitment. We've got to do something about the problems we see here." The hen said, "Let's give them a ham and egg breakfast." And the pig looked at him and said, "You know, for you that is commitment; for me that's total commitment."

It does remind you that coming in and talking and saying "amen" a few times and "we've got to do something" and "let's get the excitement of space into education, let's turn kids on," sure, that's great.

On the legal side, what are the issues with Mediasat when the media have their own photo reconnaissance satellites and can go take pictures of war zones and they can take pictures of anything else they want to on the earth and publish them and use them freely and the governments won't have control over that sort of thing anymore, not even to the extent of ordering something from SPOT Image, with a great accuracy, by the way.

What happens with those kinds of issues? They're interesting to discuss, they're important to discuss, but if you don't commit to doing something about it when you leave here as an individual and say, "I'm going to make a difference in all of this," then maybe it wasn't really a worth- while exercise.

We surely haven't gone through this exercise, if you will, of operating this Symposium for the purpose of having people go home and settle back into their own comfortable nitch again. What we are hoping we have done and are doing this afternoon in the education and legal forums is specifically to get you turned on in an informed way, in a responsible way, so you can figure out what can be done and get on with it.

So we hope you will do that, and we thank you very much,, Congressman Hefley, for your words to start us on the way.

Thanks very much.

# APPENDICES
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# ACRONYMS LISTING

ABM - Antiballistic Missile
ADEOS - Advanced Earth Observation Satellite
AFSATCOM - Air Force Satellite Communication System
AFWAL - Air Force Wright Patterson Aeronautical Laboratory
AIAA - American Institute of Aeronautics and Astronautics
ALS - Advanced Launch System
ALPS - Accidental Launch Protection System
AMPTE - Active Magnetospheric Particle Trace Experiments
AMST - Advance Military Spacecraft Technology
APL - Applied Physics Laboratory
APM - Attached Pressurized Module
AOA - Airborne Optical Adjunct
ASAT - Anti Satellite
ASE - Association of Space Explorers
ATS - Application Technology Satellite
AWPDS - Attack Warning Processing and Display System
AXAF - Advanced X-ray Astrophysics Facility
BM/C3 - Battle Management/Command, Control, Communications
BMD - Ballistic Missile Defense
BNSC - British National Space Center
BSTS - Boost Surveillance Tracking System
CAP - Civil Air Patrol
CCPDS-R - Command Center Processing and Display System Replacement
CELV - Complementary Expendable Launch Vehicle
CINC - Commander in Chief
CNES - Centre National d'Etudes Spatiales
COMSAT - Communication Satellites
CONOPS - Continental United States Operations
CONUS - Continental United States
COSPAR - Committee on Space Research
CSOC - Consolidated Space Operations Center
CSSR - Communications System Segment Replacement
DARPA - Defense Advanced Research Projects Agency
DEW - Directed Energy Weapons
DGI - Defense Group, Inc.
DMSP - Defense Meteorological Satellite Program
DOD - Department of Defense
DOE - Department of Energy
DOT - Department of Transportation
DSCS - Defense Satellite Communications System
ECS - European Communications Satellite
EHF - Extremely High Frequency
ELV - Expendable Launch Vehicle
EOSAT - Earth Observation Satellite
ERIS - Exoatmospheric Reentry Vehicle Intercept Subsystem
ERS - Earth Resource Satellite
ESA - European Space Agency
EVA - Extra-Vehicular Activity
FAA - Federal Aviation Administration
FCC - Federal Communications Commission
FEL - Free Electron Lasar
FLTSATCOM - Flat Satellite Communications
FMPT - First Material Processing Tests
FRAM - Ferroelectronic Random Access Memory
FSD - Full Scale Development
GEO - Geostationary Earth Orbit
GEODSS - Ground Based Electro-Optical Deep Space Surveillance
GOES - Geostationary Operational Environmental Satellite
GPS - Global Positioning System
GSO - Geostationary Orbit
GSC - Guiana Space Center
GTO - Geostationary Transfer Orbit
HEDI - High Endoatmospheric Defense Interceptor
HHS - Health and Human Services
HOE - Homing Overlay Experiment
HOTOL - Horizontal Take-off and Landing
IAC - Industry Application Centers
IAF - International Astronautical Federation
IBS - Inverse Bremsstrahlung
ICBM - Intercontinental Ballistic Missile
IEEE - Institute of Electrical and Electronics Engineers
IGBP - International Geosphere-Biosphere Program
IGN - French National Geographic Institute
IGY - International Geophysical Year
INTELSAT - International Telecommunications Satellite Organization
IRI - Informal Reading Inventory
ISAS - Institute of Space and Astronautical Science (Japan)
ISCOS - Institute for Security and Cooperation in Outer Space
ISE - Integrated Space Experiment
ISF - Industrial Space Facility
ISO - Infrared Space Observatory
ISU - International Space University
ISY - International Space Year
ITU - International Telecommunications Union
ITW&AA - Integrated Tactical Warning and Attack Assessment
JEM - Japan Experiment Module
JCS - Joint Chiefs of Staff
JSC - Johnson Space Center
KEW - Kinetic Energy Weapons
LANDSAT - Land Satellite
LDEF - Long Duration Exposure Facility
LEO - Low Earth Orbit

LRG - Launch Risk Guarantee
LSA - Launch Services Agreement
MAD - Mutual Assured Destruction
MCCS - Mobile Command and Control System
MILSATCOM - Military Satellite Communications
MITI - Ministry of International Trade and Industry (Japan)
MLV - Medium Launch Vehicle
MTFF - Man-tended Free Flyer
MOU - Memorandum of Understanding
NASA - National Aeronautics & Space Administration
NASDA - National Space Development Agency (Japan)
NASP - National Aerospace Plane
NATO - North American Treaty Organization
NAVSTAR - Navigation System Using Timing and Ranging
NOAA - National Oceanic and Atmospheric Administration
NORAD - North American Aerospace Defense Command
NPB - Neutral Particle Beam
NRL - Navel Research Laboratory
NROSS - Navy Remote Ocean Surveillance Satellite
NSF - National Space Foundation
NSTL - National Space Technology Laboratory
OMB - Office of Management and Budget
OPCC - Offutt Processing and Correlation Center
OPCOM - Operations Communications
PIMS - Programmable Implantable Medication System
RAM - Random Access Memory
RV - Reentry Vehicle
SA/BM - Systems Analysis and Battle Management
SAC - Space Activity Commission (Japan)
SAMSO - Space and Missile Systems Organization
SAR - Synthetic Aperture Radar
SATKA - Surveillance, Acquisition, Tracking & Kill Assessment
SCIS - Survivable Communications Integration System
SDI - Strategic Defense Initiative
SDIO - Strategic Defense Initiative Organization
SEWS - Satellite Early Warning System
SFU - Space Flier Unit
SHF - Super High Frequency
SIG-Space - Senior Inter-agency Group for Space
SLBM - Strategic Launch Ballistic Missile
SLKT - Survivability, Lethality and Key Technologies
SOPC - Shuttle Operations Planning Complex
Space WARC - Space World Administrative Radio Conference
SPADOC - Space Defense Operations Center
SPOT - Satellite Positioning and Tracking
SRB - Solid Rocket Booster
STS - Space Transportation System
TIR - Terminal Imaging Radar
TIROS - Television & Infrared Observation Satellite
UHF - Ultra High Frequency
VEB - Vehicle Equipment Bay
VHSIC - Very High Speed Integrated Circuit

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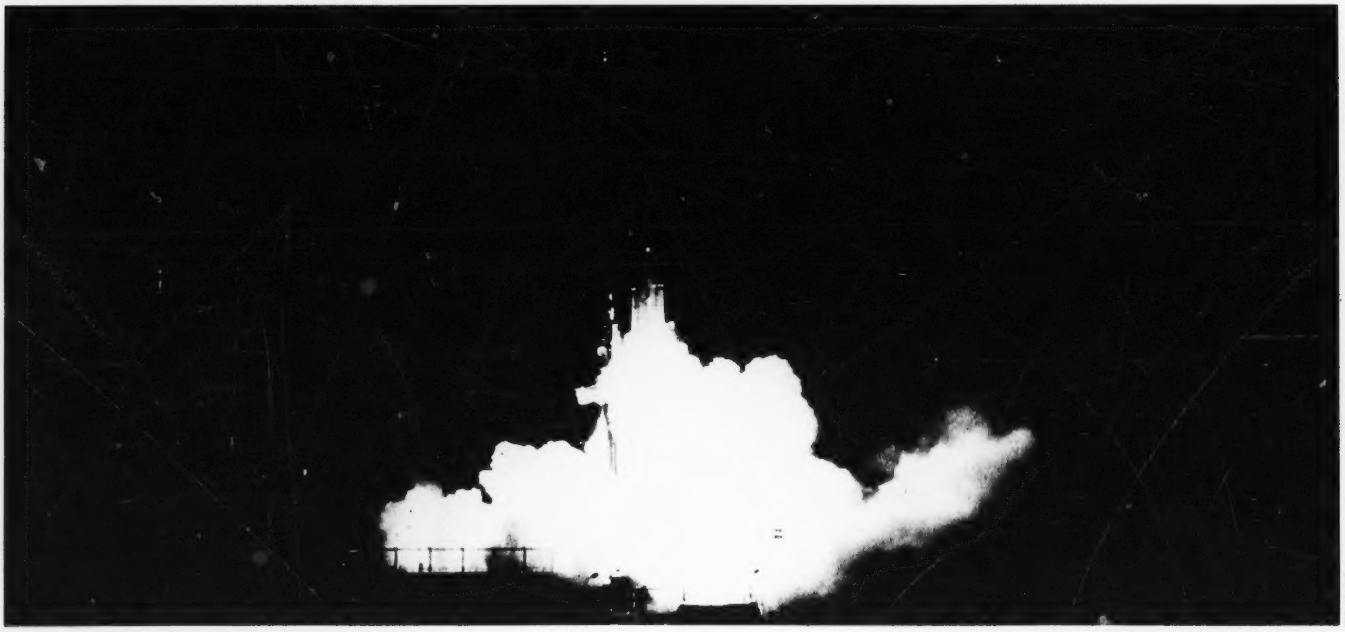

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